judgels Documentation

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ia-toki

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Contents

CHAPTER 1

Introduction

Judgels (**Judgment Angels**) is a set of modular applications for educational programming purposes. It was initiated by Ikatan Alumni Tim Olimpiade Komputer Indonesia (English: Indonesia Computing Olympiad Alumni Association). It is designed to support:

- competitive programming contests,
- competitive programming problem archive,
- academic programming classes,
- programming training courses,
- etc.

It is open source. Anyone can view and use the codebase on GitHub.

1.1 Applications

Judgels consists of several applications that work with each other. Each application has a codename after a Greek archangel name.

At the moment, there are seven applications in Judgels:

1. **Jophiel** (Single Sign-On) : authenticates and authorizes users in other applications.
2. **Sandalphon** (Repository Gate): stores programming problems and lessons.
3. **Sealtiel** (Message Gate): provides message queues and transmissions between applications.
4. **Uriel** (Competition Gate): holds programming contests.
5. **Michael** (Alchemy Gate): monitors machines used for other applications.
6. **Jerahmeel** (Training Gate): holds programming training and provides problem archive.
7. **Gabriel** (Grader): grades programming submissions.

The applications are designed to be modular. For example, multiple instances of Uriel can share the same Sandalphon and Jophiel instance. They are also designed to be distributed: the

required application instances do not have to be installed in one single machine. We can install one application in one machine and some others in other machines.

Judgels applications are still being heavily developed and do not have any stable releases yet. Anyone can try at their own risks.

1.2 Framework

All Judgels applications, except Gabriel, are developed using Play Framework 2.4.2 (Java). For convenience, we will call them **Judgels Play applications**. The Java version used is Java 8. Gabriel is written in Java 8, and uses Moe Contest Environment for the sandbox.

1.3 License

Judgels is licensed using GNU GPL version 2.

1.4 Developers

This project is currently being developed by the following people, each in alphabetical order.

1.4.1 Maintainers

- Ashar Fuadi (@fushar)
- Jordan Fernando (@dragoon20)
- Petra Novandi Barus (project manager) (@petrabarus)

1.4.2 Contributors

- Bagus Seto Wiguno (@bswig)
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- Ivan Hendrajaya (@ivanhendrajaya)
- Inggriani Liem
- Adi Mulyanto
- Arief Widhiyasa
- Derianto Kusuma
- Brian Marshal
- William Gozali

Public contributions are welcome. Please consult the Developer's Guide on how Judgels works in detail.

CHAPTER 2

Setup

A Judgels application is installed by cloning and building the source code from GitHub. A Judgels application may depend on other Judgels applications to work. Judgels is designed to be distributed, so:

- More than one applications can be installed on one machine.
- Two applications can work together regardless of whether or not they are on the same machine.

2.1 Requirements

Theoretically, all Judgels applications except Gabriel can run on any operating system. However, we have not tested thoroughly on Windows. Therefore, we strongly recommend that you use UNIX-based operating systems (Linux or OS X). Also, throughout this documentation, it will be assumed that you are using Linux or OS X.

The following programs must be installed on any machine that hosts any Judgels application:

- Oracle Java 8
- Git
- Python 3

Specific requirements for each Judgels application will be mentioned on the respective application page.

2.2 Installing main repository

Judgels consists of many repositories. Create a directory that will store Judgels repositories. We will denote it as Judgels base directory. There must be only one Judgels base directory even though more than one applications will be installed on the machine.

First, clone the main Judgels repository. This repository will act as a gate to the other Judgels repositories.

```
cd <your-Judgels-base-directory>
git clone https://github.com/ia-toki/judgels
```

Then, we will install Judgels terminal script that will enable many convenience commands in the terminal. Open your **~/.bash_profile** (or create one), and add the following lines.

```
export JUDGELS_BASE_DIR=<your-Judgels-base-directory>
alias judgels="python3 $JUDGELS_BASE_DIR/judgels/scripts/terminal.py"
```

Restart your terminal to activate the script.

More information about this command-line tool can be found here: *Command-line tool*.

2.3 Installing Activator

All Judgels applications use Typesafe Activator as the wrapper for SBT. Activator is needed for compiling, running, starting, and distributing the applications.

First, download Activator:

```
cd $JUDGELS_BASE_DIR
judgels/scripts/download-activator.sh
```

Then, add this line to your **.bashrc**:

```
export PATH=$PATH:~/activator
```

Try running Activator:

```
activator
```

If it ran, then Activator has been installed successfully.

2.4 Installing database

All Judgels Play applications requires a connection a working MySQL database server. Install a MySQL server. Then, create a database named **judgels_<app>** (note the underscore, not dash) for each Judgels Play application <app> you want to install. For example: **judgels_jophiel**.

2.5 Installing application

If you want to install a Judgels application <app>, run

```
judgels pull <app>
```

(For example: `judgels pull jophiel`.)

This will clone the repositories of the application and all its dependencies. Then, you should follow the instruction on the respective application page. But, first modify the configuration files as explained in the next section. Some configuration keys are common to all application, so the instruction is provided on this page.

2.6 Modifying configuration files

All Judgels applications require editing configuration files. This section will explain the configuration keys that are common to all applications, except Gabriel. If you are installing Gabriel, skip this section. Specific configuration keys are explained in the respective application section.

First, copy the default configuration files. Run these commands in the application repository.

```
cp conf/application_default.conf conf/application.conf
cp conf/db_default.conf conf/db.conf
cp conf/akka_default.conf conf/akka.conf
```

Here are the configuration keys you need to modify. Note that if a key is not listed here or on the specific application page, then you don't need to modify its value.

2.6.1 Application configuration

The configuration file to modify is **conf/application.conf**.

application.title The displayed title/name of application. For example: "Public Competition Gate".

application.copyright The displayed copyright/institution name that hosts the application. For example: "XXX University".

play.crypto.secret Play framework's secret key for cryptographics functions. The default value must be changed for security. See https://www.playframework.com/documentation/2.4.x/ApplicationSecret for more details.

play.http.session.secure Set to true if you use HTTPS.

<app>.baseUrl The base URL address of the application. Do not include trailing slash. For example: "http://localhost:9001". ("http://localhost:9001/" is wrong.)

<app>.baseDataDir The absolute path of a local directory that hosts this application's data files. For example: "/home/user/judgels/data/jophiel".

googleAnalytics.{use, id} Set **use** to true to enable Google Analytics reporting. If used, set **id** to the Google Analytics ID.

2.6.2 Database configuration

The configuration file to modify is **conf/db.conf**.

url Fill it with database URL. If you install MySQL in localhost, the value should be "jdbc:mysql://localhost/judgels_<app>".

username Database's username.

password Database's password.

2.6.3 Akka configuration

Akka is used for concurrency management. It is safe to use the default configuration without modification.

2.7 Running Judgels Play applications

After the installation and configuration, we can run Judgels play applications in two modes.

2.7.1 Development mode

Run the `judgels run <app>` command. This mode is intended for development environment. Classes will be automatically recompiled if there are changes in the corresponding source files, without having to restart the application.

2.7.2 Production mode

In production mode, we will deploy standalone executable files without the source code.

1. Run the `judgels dist <app>` command. It will create a zip file JUDGELS_BASE_DIR/dist/**<app>-<version>.zip**.
2. Copy the zip file to the target machine, in its own JUDGELS_BASE_DIR/dist directory.
3. Unzip the file. There should be a directory JUDGELS_BASE_DIR/dist/<app>-<version>.
4. If you run in HTTPS, you have to create a directory **conf** inside the above directory. This is probably a Play framework bug, and has been reported in this GitHub issue.
5. Run the `judgels start <app> <version>` or `judgels start-https <app> <version>` command.

2.7.3 Setting Nginx reverse proxy

The URLs like http://localhost:900x are ugly. We can set up nice domain names using Nginx reverse proxy.

1. Install Nginx.

2. Set up virtual hosts. Assume that we want to set up Jophiel. Create a file named **jophiel** in **/etc/nginx/sites-available/** with this content:

```
server {
    listen 80;
    server_name jophiel.judgels.local;

    location / {
        proxy_pass              http://localhost:9001;
        proxy_set_header        Host $host;
        proxy_set_header        X-Real-IP $remote_addr;
        proxy_set_header        X-Forwarded-For $proxy_add_x_forwarded_for;
        proxy_connect_timeout   150;
        proxy_send_timeout      100;
        proxy_read_timeout      100;
    }
}
```

   The virtual host setting files for the other applications are similar. Just modify the server name and port number accordingly. The above server name is recommended for local development setup.

3. Enable the virtual host.

```
cd /etc/nginx/sites-enabled
sudo ln -s ../sites-available/jophiel .
```

4. Reload Nginx.

5. Make the server name point to the server IP address. For local development setup, this can be done by adding this line to **/etc/hosts**:

```
127.0.0.1    jophiel.judgels.local
```

   For production setup, add the subdomain on your domain management web interface.

6. That's it. The Judgels application can be opened on your browser using the new server name (in this case, http://jophiel.judgels.local).

CHAPTER 3

Command-line tool

Judgels comes with a handy command-line tool to make repetitive tasks easier.

3.1 Installation

First, make sure that you:

- Have a directory that will hosts all Judgels repositories. This directory is called Judgels base directory.
- Have cloned **judgels** repository to the base directory.
- Have Python 3 installed.

Open your **~/.bashrc** (or create one), and add the following lines.

```
export JUDGELS_BASE_DIR=<your-Judgels-base-directory>
alias judgels="python3 $JUDGELS_BASE_DIR/judgels/scripts/terminal.py"
```

Restart your terminal to activate the script.

3.2 Usage

All commands take the form of `judgels <command> [ <args> ... ]`. In all commands, <*repo*> is one of Judgels' repositories, while <*app*> is one of Judgels' applications, in lowercase (like jophiel, sandalphon, etc.). Omit `judgels-` prefix for <*repo*> and <*app*>. For example, to clean the build in **judgels-play-commons** repository, run `judgels clean play-commons`.

The available commands are as follows.

judgels clean <repo> Cleans the build in <repo>. This is equivalent to running `./activator clean` in <repo>.

judgels dist <repo> Creates a standalone distribution for <repo>. This is equivalent to running `./activator clean && ./activator dist` in <repo>.

judgels kill <app> Kills a running Judgels application <app> in start mode (i.e., that was run by `judgels start <app>` command).

judgels pull <repo> Pulls changes from the repository <repo> and all its dependencies, using `--rebase` strategy. If any of the repository or its dependencies is not present, it will be cloned.

<repo> can be `--all`; this will pull/clone all Judgels repositories.

judgels push <repo> Pushes changes from the repository <repo> and all its dependencies.

<repo> can be `--all`; this will push all Judgels repositories.

judgels release <version> Bumps a new version for all Judgels repositories. For Judgels admins only.

judgels run <app> [<port>] Runs the application <app>. This is equivalent to running `./activator run [ -Dhttp.port=<port> ]` in <repo>.

If <port> is omitted, the defaults are:

- jophiel: 9001
- sandalphon: 9002
- sealtiel: 9003
- uriel: 9004
- michael: 9005
- jerahmeel: 9006

judgels start <app> <version> [<port>] Starts the application from the standalone distribution created using `judgels dist` command. This is equivalent to running the standalone executable on the specified port. The Judgels application version must be specified. The default ports are the same as above.

judgels start-https <app> <version> [<port>] Same as above, but using HTTPS.

judgels status For each Judgels application, it will be output to the screen whether or not is currently running in start mode.

CHAPTER 4

Jophiel (Single Sign-On)

Jophiel is a Judgels application that authenticates and authorizes users in other Judgels applications. The motivation is that a user should have only a single account accross all Judgels applications.

Jophiel uses OpenID Connect protocol.

4.1 Setup

4.1.1 Installing Jophiel

First, follow the *main Judgels setup* instructions if you haven't. This means that you should have installed Jophiel by running

```
judgels pull jophiel
```

and should have modified the common configuration keys in **conf/application.conf** and **conf/db.conf**.

4.1.2 Configuring Jophiel

This section will cover the specific configuration keys for Jophiel.

play.mailer.{host, port, ssl, user, password} SMTP credentials configuration for sending user account related emails.

jophiel.idToken.key.private An RSA private key for generating ID token required for OpenID Connect protocol. You can generate one using `ssh-keygen` command. Make sure to select RSA as the algorithm.

jophiel.client.{labels, targets} The list of public Judgels Play applications you want to inform to the users on the welcome page. This is useful in order to users that have just logged in not to get lost in SSO. Put the list of URLs in **targets**, and the corresponding link labels in **labels**.

noreply.{name, email} The name and email of "noreply" user for sending user account related emails.

aws.avatar.s3.use Whether to use AWS as the storage for user avatars. If set to true, then the rest of the **aws.avatar.*** keys below should be modified accordingly.

aws.avatar.s3.{bucket.name, bucket.regionId} The bucket name and bucket region ID for the S3 storage.

aws.avatar.cloudFront.baseUrl The base URL for CloudFront for the S3 storage. You must set up CloudFront.

aws.key.use Whether a pair of keys must be used for connecting to S3. For example, if the EC2 that hosts Jophiel has been associated to a role that has permission for connecting to S3, then this value should be false.

aws.key.{access, secret} If a pair of keys must be used, then these are the access and secret keys, respectively.

recaptcha.registration.use Whether to use reCAPTCHA for the registration form.

recaptcha.registration.key.{site, secret} If reCAPTCHA is used, then these are the site and secret keys, respectively.

4.1.3 Running Jophiel

See *Running Judgels Play applications*.

4.1.4 Adding initial admin

Jophiel has been successfully installed and configuring. Now, we need to have a user with admin role.

1. Open Jophiel. You will be presented with a login screen. Choose Register.
2. Register a user to be assigned as admin.
3. Validate the user by following the validation email. If you don't have a valid SMTP server setup, you can do the validation manually by setting the **emailVerified** column to **1** in the corresponding row in the **jophiel_user_email** table.
4. Manually assign this user as admin, by setting the **roles** column to **user,admin** in the corresponding row in the **jophiel_user** table.
5. Log in to Jophiel. Verify that you can view the **Users** menu on the left.

4.2 Manual

4.2.1 User roles

There are two roles in Jophiel:

User A normal user.

Admin An administrator. Can do anything, for example, user CRUD and Jophiel client CRUD.

4.2.2 Adding Jophiel clients

A Jophiel client is an application that uses Jophiel for authentication and authorization. To add a Jophiel client, perform these steps.

1. Open Jophiel and click **Clients** menu on the left.
2. Click **Create New**.
3. Fill in these values:

   Client Name The client name. For example: **Sandalphon #1**.

   Application Type Choose **Web Server**.

   Redirect URIs Fill **<client base URL>/verify**. For example: **http://localhost:9002/verify**.

   Scopes For the current version, choose **OPENID** and **OFFLINE_ACCESS**.
4. Click **Create New**.

A Jophiel client has been successfully created with the corresponding client JID and client secret. The client can then connect to Jophiel using the JID and secret.

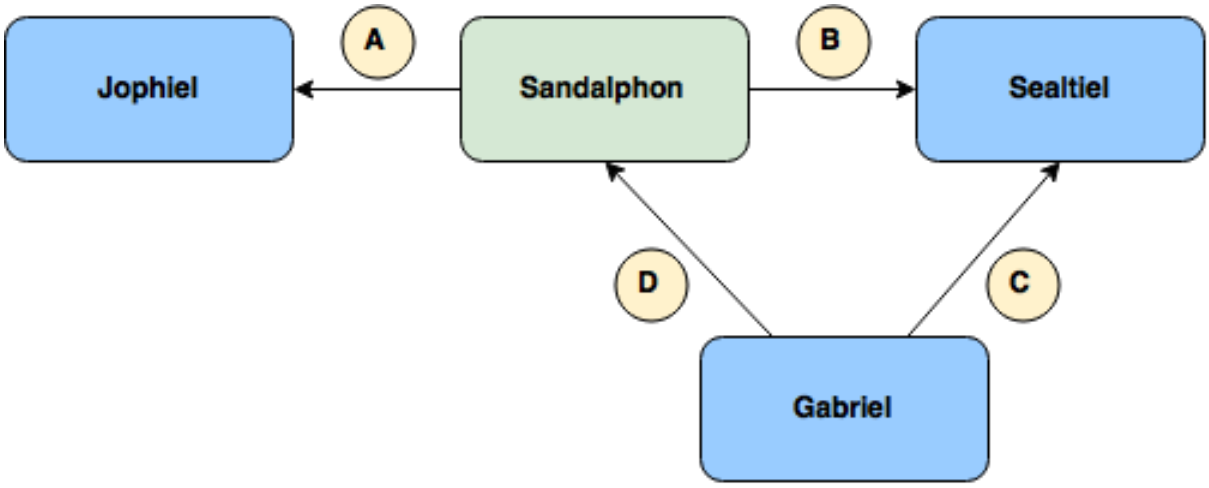
CHAPTER 5

Sandalphon (Repository Gate)

Sandalphon is a Judgels application that stores programming resources, for example, problems and lessons.

5.1 Dependencies

Sandalphon depends on other Judgels applications to run correctly. Here is the dependency diagram.



An arrow pointing from A to B means that A depends on B. The dependencies between applications are described as follows.

1. Sandalphon connects to Jophiel for user authentication and authorization.
2. Sandalphon connects to Sealtiel for sending grading requests and polling grading responses.
3. Gabriel connects to Sealtiel for polling grading requests and sending grading responses.
4. Gabriel connects to Sandalphon for fetching test cases.

5.2 Setup

5.2.1 Installing dependencies

As described in the previous section, Sandalphon depends on Jophiel, Sealtiel, and Gabriel. Make sure you have installed them.

5.2.2 Installing Sandalphon

First, follow the *main Judgels setup* instructions if you haven't. This means that you should have installed Sandalphon by running

```
judgels pull sandalphon
```

and should have modified the common configuration keys in **conf/application.conf** and **conf/db.conf**.

5.2.3 Configuring Sandalphon

First, let's configure the dependencies so that they can work with Sandalphon. During the configuration, we will set some configuration keys in Sandalphon's **conf/application.conf**.

1. Add Sandalphon as a client in Jophiel. Then, assign the client JID and secret values to Sandalphon's **jophiel.clientJid** and **jophiel.clientSecret**. Assign **jophiel.baseUrl** to Jophiel's base URL.
2. Add Sandalphon as a client in Sealtiel. Then, assign the client JID and secret values to Sandalphon's **sealtiel.clientJid** and **sealtiel.clientSecret**. Assign **sealtiel.baseUrl** to Sealtiel's base URL.
3. Add Gabriel as a client in Sealtiel. Then, assign the client JID and secret values to **Gabriel**'s **sealtiel.clientJid** and **sealtiel.clientSecret**. Assign **Gabriel**'s **sealtiel.baseUrl** to Sealtiel's base URL. Finally, assign the client JID to **Sandalphon**'s **sealtiel.gabrielClientJid**.
4. Add acquaintances between Sandalphon and Gabriel, vice-versa, in Sealtiel.

5.2.4 Running Sandalphon

See *Running Judgels Play applications*.

5.2.5 Configuring Gabriel

Finally, add Gabriel as a Sandalphon's grader. This is required to allow Gabriel to fetch test cases from Sandalphon. It is worth noting that Gabriel connects directly to Sandalphon for fetching test cases, not via Sealtiel, since this should be a synchronous operation.

1. Open Sandalphon and click **Graders** menu on the left.
2. Click **Create New**.
3. Fill in these values:

   Name The grader name. For example: **Gabriel #1**.
4. Click **Create New**.

Assign the JID and secret you obtained to Gabriel's **sandalphon.clientJid** and **sandalphon.clientSecret**. Assign Gabriel's **sandalphon.baseUrl** to Sandalphon's base URL.

5.2.6 Adding initial admin

Sandalphon has been successfully installed and configured. Now, we need to have a user with admin role.

1. Find your user JID in Jophiel.
2. Set the **roles** column to **user,admin** in the corresponding row (that contains your user JID) in the **sandalphon_user** table.
3. Re-log in to Sandalphon. Verify that you can view the **Clients** menu on the left.

5.3 Manual

5.3.1 Resources

Resource types

There are two types of resources that are supported by Sandalphon: problems and lessons. The resources can be used by **Sandalphon clients**, for example, Uriel and Jerahmeel.

Problems

Problem types Currently, there are two types of problems that are supported in Sandalphon: programming problems and bundle problems.

Programming problems Currently, only **blackbox**-type programming problems are supported. Blackbox means that contestant submissions are graded based on the outputs on the provided **test cases**. The submission source code is not checked.

The specific configuration for programming problems can be found in **Grading** tab.

Test data concepts

Test cases A test case is the smallest unit of grading data. It consists of several files. Test cases that appear in the problem statement are called sample test cases.

When the contestant program is evaluated against a test case, the **verdict** can be one of the following, from the lowest **priority** to the highest **priority**:

- **AC** (Accepted): the contestant program is considered correct.
- **OK X** (OK): the contestant program is partially correct, with X points.
- **WA** (Wrong Answer): the contestant program is considered incorrect.
- **RTE** (Runtime Error): the contestant program crashed; may be because it exceeded the memory limit.
- **TLE** (Time Limit Exceeded): the contestant program did not stop within the time limit.
- **SKP** (Skipped): the contestant program was not run at all. This will be explained in problems with subtasks.

Time limit The maximum time (not wall time) a contestant program can run on a test case.

Memory limit The maximum memory a contestant program can consume. Stack size is only limited by this memory limit.

Source code limit Currently it is hardcoded to **300 KB**.

Programming problem types Blackbox problems are classified based on two aspects: **evaluation methods** and **scoring methods**. Based on evaluation methods, there are two types: **batch** and **interactive**. Based on scoring methods, there are two types: **with subtasks** and **without subtasks**.

Batch problems This is the standard and most common programming problem type. For each test case, the contestant program reads the input file and produced an output file. (In the program perspective, it reads from standard input and writes to standard output.) By default, the test case verdict is AC if the produced output file match exactly with the inteded output file, or WA otherwise.

It is also possible that in some problems, multiple answers are considered correct, or even partially correct. In order to support that, it is possible to write a custom **scorer** that decided the test case verdict. See the **Helper files** section for more details.

Interactive problems For each test case, the contestant program interacts with the so-called **communicator** program. There is only test case input file. The communicator program also decides the test case verdict, based on the interaction result. See the **Helper files** section for more details on writing communicator program.

Problems without subtasks The score of a submission to this problem is simply the sum of test case scores.

The score of a test case is defined based on the test case verdict:

- If the verdict is **AC**, then the test case score is **100.0 / (number of test cases)**.
- If the verdict is **OK X**, then the test case score is **X**.
- If the verdict is anything else, then the test case score is **0**.

The verdict of a submission is the verdict with the highest priority among the test case verdicts.

Problems with subtasks This type of problem introduces new concepts: **subtasks** and **test groups**.

Subtasks A subtask is a set of constraints. A problem can have multiple subtasks (multiple set of constraints), to give nicer score distribution. For example, a problem can have 3 subtasks with these sets of constraints:

1. N = 1, 1 <= K <= 100
2. 1 <= N <= 100, K = 1
3. 1 <= N <= 100, 1 <= K <= 100

A test case should be assigned to a subtask if the test case satisfy all constraints in the subtask.

Test groups A test group is a set of test cases that are assigned to the same set of subtasks. Test groups are introduced to simplify the organization of assignment of test cases and subtasks. For example, for the above problem, we can create 4 test groups as follows:

1. Consists of only one test case N = K = 1. Assign it to subtasks {1, 2, 3}.
2. Test cases that satisfy N = 1; 2 <= K <= 100. Assign them to subtasks {1, 3}.
3. Test cases that satisfy 2 <= N <= 100; K = 1. Assign them to subtasks {2, 3}.
4. Test cases that satisfy 2 <= N, K <= 100. Assign them to subtasks {3}.

The score of a submission is the sum of the score of each subtask.

The score of a subtask is:

- the points assigned to the subtask, if each test case assigned to the subtask has **AC** verdict, or
- **0**, if at least one test case assigned to the subtask does not have **AC** verdict.

The verdict of a subtask is the verdict with the highest priority among the test case verdicts.

The verdict of a submission is the verdict with the highest priority among the subtask verdicts.

If a test case will not affect the verdicts of all subtasks assigned to it anymore, the test case will be skipped (has Skipped verdict). For example, if a test case is assigned to Subtask 1, but there has been a test case in Subtask 1 that is not Accepted, then that test case will be skipped.

Grading engines Based on the classifications above, there are 4 types of programming problems supported in Sandalphon. The type is referred to as **grading engine**.

- Batch
- Batch with subtasks
- Interactive
- Interactive with subtasks

Helper files These files should be uploaded to the Helpers section in grading configuration. You must upload the **source code**, not the executable program. The helper files mostly decide test case verdicts.

The test case verdict takes one of the following format:

- Accepted

```
AC
<info>
```

- OK

```
OK
X <info>
```

  where **X** is the score. Can be a floating-point value.

- Wrong Answer

```
WA
<info>
```

In all cases, **<info>** is an additional info which will be given to the contestants in the submission result details. For example, in a binary search interactive problem, the additional info may be the number of guesses the contestant program gave. If you don't want to give additional info, just omit it. In AC and WA verdicts, just omit the second line altogether.

Scorer A scorer is a C++ program which decides the verdict of a test case in batch problems.

The scorer will receive the following arguments:

- argv[1]: test case input filename
- argv[2]: test case output filename
- argv[3]: contestant's produced output filename

The scorer must print the test case verdict to the **standard output (stdout)**.

Here is an example scorer program which gives AC if the contestant's output differs not more than 1e-9 with the official output.

```cpp
#include <fstream>
#include <iostream>
#include <algorithm>
using namespace std;

int wa() {
    cout << "WA" << endl;
    return 0;
}

int ac() {
    cout << "AC" << endl;
    return 0;
}

int main(int argc, char* argv[]) {
    ifstream tc_in(argv[1]);
    ifstream tc_out(argv[2]);
    ifstream con_out(argv[3]);

    double tc_ans;
    tc_out >> tc_ans;

    double con_ans;
    if (!(con_out >> con_ans)) {
        return wa();
    }

    if (abs(tc_ans - con_ans) < 1e-9) {
        return ac();
    } else {
        return wa();
    }
}
```

Communicator A communicator is a C++ program which interacts with the contestant program in interactive problems, and then decides the verdict of a test case.

The communicator will receive the following argument:

- argv[1]: test case input filename

During the interaction, the communicator can read the contestant program's output from the **standard input (stdin)**, and can give input to the contestant program by writing to the **standard output (stdout)**. Make sure the communicator flushes after every time it writes output.

Ultimately, the communicator must print the test case verdict to the **standard error (stderr)**. Note that (currently) the interaction is not guaranteed to stop after the verdict has been output, the interaction may exceed the time limit if neither it or contestant program stops.

Here is an example communicator program in a typical binary search problem. In this example,

the organizer wants that the number of guesses be output in an AC verdict.

```
#include <fstream>
#include <iostream>
using namespace std;

int wa() {
    cerr << "WA" << endl;
    return 0;
}

int ac(int count) {
    cerr << "AC" << endl;
    cerr << "guesses = " << count << endl;
    return 0;
}

int main(int argc, char* argv[]) {
    ifstream tc_in(argv[1]);

    int N;
    tc_in >> N;

    cout << N << endl;

    int guesses_count = 0;

    while (true) {
        int guess;

        cin >> guess;
        guesses_count++;

        if (guesses_count > 10) {
            return wa();
        } else if (guess < N) {
            cout << "TOO_SMALL" << endl;
        } else if (guess > N) {
            cout << "TOO_LARGE" << endl;
        } else {
            return ac(guesses_count);
        }
    }
}
```

Language restriction You can limit which programming languages are allowed for a submission to a problem, in the **Language Restriction** subtab.

Bundle problems TBA

Creating problems To create a new problem in Sandalphon, perform these steps:

1. Open Sandalphon and click **Problems** on the left.
2. Click **Create New**.
3. Fill in these values:

   Type The problem type.

   Name The problem name.

   Additional Note Any additional note. For example, problem tags, contests that have used the problems, etc.

   Initial Language The initial language of the problem statement. Later, you can add other languages.
4. Click **Create New**.

Managing statements After you created a problem, you can view and update the statement(s).

Media You can insert images to the statement. Upload the image as media file in the **Media** subtab, and then insert it to the statement by adding an image with this URL: **render/<imageFilename>**. Currently only images are supported.

Languages You can have multiple languages of the statements. You can add new languages in the **Languages** subtab. **Default language** is the default language shown to the user. You can also disable a language. When viewing problem statement, users can switch languages.

Currently, problem names cannot be translated.

Managing partners You can share the privilege to modify the problem you created to other users (called "partners"). Add the username of the user you want to share, in the **Partners** subtab. You can specify the permissions you want to grant.

Managing versions Every changes to a problem will be tracked in a version control. Every time you finished making a change, you have to **commit** your change. When you commit, one of the following events will happen:

- The commit succeeded. Your changes will be recorded.
- New commits have been made since you started editing. You will be prompted to update your local working copy. Click **Update Working Copy**. One of the following events will happen:
  - Update working copy succeeded. You can continue committing.
  - Update working copy failed. Your changes conflicts with the previous commits. Currently, there is no solution. You have to remember/save your changes somewhere and then click **Discard Local Changes** to discard your changes and load the latest version.

Note that you can also update working copy or discard local changes any time during your modification.

Adding Sandalphon clients

Before an application can use Sandalphon resources, it must be registered as a Sandalphon client.

1. Open Sandalphon and click **Clients** menu on the left.
2. Click **Create New**.
3. Fill in these values:

   Name The client name. For example: **Uriel #1**.
4. Click **Create New**.

A Sandalphon client has been successfully created with the corresponding client JID and client secret. The client can then connect to Sandalphon using the JID and secret.

Sharing resources to Sandalphon clients

If a Sandalphon client wants to use a resource from Sandalphon, perform these steps.

1. Enter the corresponding resource (problem/lesson).
2. Click the **Clients** tab.
3. Choose the client, and then click **Create New**.
4. View the client. You will see the resource JID and resource secret, for that particular client.

The client can then fetch the resource from Sandalphon, using the provided resource JID and resource secret.

CHAPTER 6

Sealtiel (Message Gate)

Sealtiel is the bridge that handles asynchronous messages between Judgels applications. Currently it is only used for delivering grading requests and responses between Gabriel and the other Judgels applications.

Internally, Sealtiel uses RabbitMQ.

6.1 Setup

6.1.1 Installing RabbitMQ

Sealtiel internally uses RabbitMQ. So, it must be installed first. Follow the installation instruction here: Downloading and Installing RabbitMQ. Make sure you install at least version **3.5.x**.

After you installed RabbitMQ, enable the management plugin:

```
sudo rabbitmq-plugins enable rabbitmq_management
```

If everything goes well, you should be able to open the management web interface on http://localhost:15672. You can login with the default user (username: **guest**, password: **guest**).

6.1.2 Configuring RabbitMQ

For security, you must change the guest user password.

1. Log in to the management web interface.
2. Click **Admin** tab.
3. Click **guest** user.
4. On the **Update this user** section, enter new password.
5. Click **Update user**.

6.1.3 Installing Sealtiel

First, follow the *main Judgels setup* instructions if you haven't. This means that you should have installed Sealtiel by running

```
judgels pull sealtiel
```

and should have modified the common configuration keys in **conf/application.conf** and **conf/db.conf**.

6.1.4 Configuring Sealtiel

This section will cover the specific configuration keys for Sealtiel.

sealtiel.{username, password} The credentials for logging in to Sealtiel. Note that Sealtiel does not use Jophiel for logging in.

rabbitmq.{host, port, username, password, virtualHost} The credentials for connecting to RabbitMQ. In most cases, you only need to change **rabbitmq.password** to the new guest password.

6.1.5 Running RabbitMQ

Run

```
sudo rabbitmqctl start_app
```

If RabbitMQ was installed correctly, this will be output:

```
                RabbitMQ 3.5.X. Copyright (C) 2007-2014 GoPivotal, Inc.
##  ##      Licensed under the MPL.  See http://www.rabbitmq.com/
##  ##
##########  Logs: /usr/local/var/log/rabbitmq/rabbit@localhost.log
######  ##        /usr/local/var/log/rabbitmq/rabbit@localhost-sasl.log
##########
            Starting broker... completed with X plugins.
```

6.1.6 Running Sealtiel

See *Running Judgels Play applications*.

To check whether Sealtiel can connect to RabbitMQ, choose the **Connection** menu in Sealtiel's left sidebar. The connection status will be shown.

6.2 Manual

6.2.1 Adding Sealtiel clients

A Sealtiel client is an application that uses Sealtiel as a bridge for sending and receiving asynchronous messages. Since Sealtiel is currently only used for sending and receiving grading requests and responses, there are only two kinds of applications that use Sealtiel: Gabriel and the applications that can request grading (Sandalphon, Uriel, and Jerahmeel).

To add a Sealtiel client, perform these steps.

1. Open Sealtiel and click **Clients** menu on the left.
2. Click **Create New**.
3. Fill in these values:

   Name The client name. For example: **Uriel #2**.
4. Click **Create New**.

A Sealtiel client has been successfully created with the corresponding client JID and client secret. The client can then connect to Sealtiel using the JID and secret.

6.2.2 Adding acquaintances

For client A to be able to send message to client B, client B must registered as client A's "**acquaintance**". Think of acquaintance as a directed edge between clients.

To add acquaintances to a Sealtiel client, perform these steps.

1. Open Sealtiel and click **Clients** menu on the left.
2. Click the Enter icon on the rightmost column of the corresponding client row.
3. Add the client name(s) as a new acquaintance.

For example, when setting up Sandalphon and Gabriel to work together, you must:

- Add Sandalphon and Gabriel as Sealtiel clients.
- Add Gabriel as Sandalphon's acquaintance.
- Add Sandalphon as Gabriel's acquaintance.

6.2.3 Watching messages

You can watch the message flow between clients in the **Queues** tab on the management web interface.

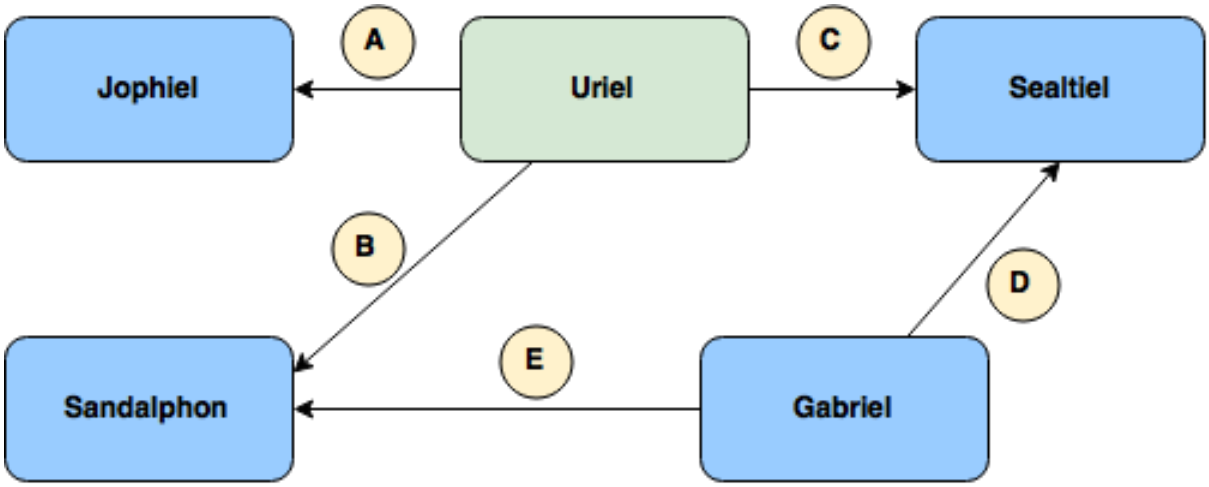
CHAPTER 7

Uriel (Competition Gate)

Uriel is a Judgels application that holds programming contests.

7.1 Dependencies

Uriel depends on other Judgels applications to run correctly. Here is the dependency diagram.



An arrow pointing from A to B means that A depends on B. The dependencies between applications are described as follows.

1. Uriel connects to Jophiel for user authentication and authorization.
2. Uriel connects to Sandalphon for fetching resources (problems/lessons).
3. Uriel connects to Sealtiel for sending grading requests and polling grading responses.
4. Gabriel connects to Sealtiel for polling grading requests and sending grading responses.
5. Gabriel connects to Sandalphon for fetching test cases.

Note that the Gabriel used for grading submissions from Uriel can be the same Gabriel used for grading submissions from Sandalphon.

7.2 Setup

7.2.1 Installing dependencies

As described in the previous section, Sandalphon depends on Jophiel, Sandalphon, Sealtiel, and Gabriel. Make sure you have installed them.

7.2.2 Installing Uriel

First, follow the *main Judgels setup* instructions if you haven't. This means that you should have installed Uriel by running

```
judgels pull uriel
```

and should have modified the common configuration keys in **conf/application.conf** and **conf/db.conf**.

7.2.3 Configuring Uriel

First, let's configure the dependencies so that they can work with Uriel. During the configuration, we will set some configuration keys in Uriel's **conf/application.conf**.

1. Add Uriel as a client in Jophiel. Then, assign the client JID and secret values to Uriel's **jophiel.clientJid** and **jophiel.clientSecret**. Assign **jophiel.baseUrl** to Jophiel's base URL.
2. Add Uriel as a client in Sealtiel. Then, assign the client JID and secret values to Uriel's **sealtiel.clientJid** and **sealtiel.clientSecret**. Assign **sealtiel.baseUrl** to Sealtiel's base URL.
3. Add Uriel as a client in Sandalphon. Then, assign the client JID and secret values to Uriel's **sandalphon.clientJid** and **sandalphon.clientSecret**. Assign **sandalphon.baseUrl** to Sandalphon's base URL.
4. Add Gabriel as a client in Sealtiel. Then, assign the client JID and secret values to **Gabriel**'s **sealtiel.clientJid** and **sealtiel.clientSecret**. Assign **Gabriel**'s **sealtiel.baseUrl** to Sealtiel's base URL. Finally, assign the client JID to **Uriel**'s **sealtiel.gabrielClientJid**.
5. Add acquaintances between Uriel and Gabriel, vice-versa, in Sealtiel.

The rest of configuration keys are:

aws.{teamAvatar, submission, file}.s3.use Whether to use AWS as the storage for {team avatars, submission files, contest files}. If set to true, then the rest of the **aws.{teamAvatar, submission, file}.*** keys below should be modified accordingly.

aws.{teamAvatar, submission, file}.s3.bucket.name The bucket name for the S3 storage.

aws.{teamAvatar, submission, file}.s3.bucket.regionId The bucket region ID for the S3 storage. If not present, **aws.global.s3.bucket.regionId** will be used.

aws.teamAvatar.cloudFront.baseUrl The base URL for CloudFront for the S3 storage. You must set up CloudFront.

aws.{teamAvatar, submission, file}.key.use Whether a pair of keys must be used for connecting to S3. For example, if the EC2 that hosts Jophiel has been associated to a role that has permission for connecting to S3, then this value should be false. If not present, then **aws.global.key.use** will be used.

aws.{teamAvatar, submission, file}.key.{access, secret} If a pair of keys must be used, then these are the access and secret keys, respectively. If not present, then **aws.global.key.{access, secret}** will be used.

7.2.4 Running Uriel

See *Running Judgels Play applications*.

7.2.5 Adding initial admin

Uriel has been successfully installed and configured. Now, we need to have a user with admin role.

1. Find your user JID in Jophiel.
2. Set the **roles** column to **user,admin** in the corresponding row (that contains your user JID) in the **uriel_user** table.
3. Re-log in to Uriel. Verify that you can view the **Users** menu on the left.

7.3 Manual

7.3.1 Contests

Configurations

Creating contests

1. Open Uriel and click **Contests** on the left.
2. Click **Create New**.
3. Fill in the values. Most fields are self-explanatory. The ones that aren't are:

   Exclusive Contests? If true, then if this contest is running for a contestant, then the he cannot access the other contests.

   Use Scoreboard? Whether to enable scoreboard in the contest.

   Incognite Scoreboard? If true, then a contestant can only view his score in the scoreboard.

Requires Password Whether a contestant must type a contest password to enter a contest.

The configuration you just filled above is general configuration. Specific configuration are available depending on the classification below.

Contest classifications

Contests in Uriel are classified based on three aspects: **types**, **scopes**, and **styles**.

Contest types

Standard A normal contest with fixed contest times. Configuration specific to this type are:

Scoreboard freeze time When to freeze the scoreboard.

Official scoreboard allowed? Whether to show the official (unfrozen) scoreboard.

Virtual A contest where the contestants can choose when they start their contest themselves. Configuration specific to this type are:

Contest duration The duration of the contest for each contestant.

Who can start the contest? Can be Contestant (for indivudal contests) or Coach (for team-based contests).

Contest scopes

Public Everyone can join this contest. Configuration specific to this type are:

Register start time Registration start time.

Register end time Registration end time.

Max registrants 0 for unlimited.

Private A user must be added manually to this contest to participate.

Contest styles

IOI IOI-style contest.

ICPC ICPC-style contest. Currently NOT IMPLEMENTED.

Both styles have language restriction specific configuration. Ultimately, the languages allowed for a problem in a contest are, the intersection of languages allowed for the problem in Sandalphon, and languages allowed for the contest.

Roles

New contests can only be created by admins.

For each contest, there are three roles:

Managers Managers of a contest are assigned by admins. Managers can:

- Update contest configurations.
- Assign supervisors.
- Do everything a supervisor can.

Supervisors Supervisors of a contest are assigned by managers (or admins). Supervisors can perform some aspects in a contest based on the list of permissions assigned to them. For example: supervising announcements, clarifications, etc.

Contestants Can do contests.

Problems

Adding problems to contests

To add problems to a contest, perform the following steps:

1. Enter the contest.
2. Click **Problems** tab.
3. Click **Supervisor** subtab.
4. Click **Create New**.
5. Fill in the following values:

   Alias Alias for the problem in the contest. For example: **A**, **B**, **C**, etc.

   Problem JID, Problem Secret The credentials you obtained after you share the problem to this Uriel, in Sandalphon.

   Submissions Limit Maximum number of submissions allowed. 0 if no limit.

   Status Can be one of the following:

   - **Open**: problem is visible and used in the contest.
   - **Closed**: problem is visible and used in the contest, but submissions are disabled.
   - **Unused**: problem is not visible and not used in the contest.

Contestants

Team-based contests

It is possible to conduct a team-based contest in Uriel. Teams can be assigned in the **Teams** subtab in **Contestants** tab. Team-based contests work best for virtual contests. The use case is similar to APIO (Asia-Pacific Informatics Olympiad):

- A contestant is assigned to a team.

- In a team, there are coaches.
- The coaches start the contests for their contestants (in virtual contests).
- The coaches can view the scoreboard for their contestants.

Files

You can upload files to a contest and have the link available in announcements. Upload the file in the **Files** tab. Then, you can insert the link in announcements as **download/<filename>**.

CHAPTER 8

Michael (Alchemy Gate)

TBA

CHAPTER 9

Jerahmeel (Training Gate)

TBA

CHAPTER 10

Gabriel (Grader)

Gabriel's job is receiving programming submissions, grading them, and then sending back the results, via Sealtiel. Internally, it runs the contestants' programs in a sandbox: Moe Contest Environment.

10.1 Setup

10.1.1 Requirements

The following are necessary for install Gabriel and the Moe sandbox correctly.

- Linux. We have only tested Gabriel in Ubuntu 14.04, so we recommend you to use it. Note that Moe cannot be installed in Windows or OS X.
- GCC.

Currently, programming languages that are supported are hardcoded to Gabriel: C, C++, Pascal, and Python 3. The following are necessary in order to use the languages:

- GCC >= 4.7 (for C/C++ language support)
- Free Pascal (for Pascal language support)
- Python >= 3 (for Python 3 language support)

10.1.2 Installing Gabriel

First, follow the *main Judgels setup* if you haven't. Then, install Gabriel:

```
judgels pull gabriel
```

This will clone Gabriel and Moe repositories to your Judgels base directory. Next, we will need to build the Moe sandbox program.

Note: The next three sections (Moe, control groups, quota) can be skipped if you plan to install Moe later. Just comment out the keys **moe.{isolatePath, iwrapperPath}** in the configuration. Gabriel can still run but the contestants' programs will not be sandboxed (which is dangerous).

This can be useful if you want to test Gabriel's connection with the other applications first.

10.1.3 Building Moe

Run these commands inside **judgels-moe** repository.

```
./configure
make
```

If the above commands finished correctly, then you will have two executable files:

- Isolate (**obj/isolate/isolate**): the main sandbox
- Interactive wrapper (**obj/eval/iwrapper**): wrapper for interactive problems

The above executables are necessary for Gabriel. If you cannot find them, that means your build failed. Resolve the errors and try again.

10.1.4 Installing control groups in Linux

Isolate needs control groups feature in Linux for sandboxing contestants' programs. You need to install it:

```
sudo apt-get install cgroup-bin
```

Then, we have to enable the memory and swap accounting in control groups. Follow these steps.

1. Add swap partition to your system if it does not have any. Note that a swap partition is **mandatory** for Isolate to function properly.
2. Open the **/etc/default/grub** using sudo privilege.
3. Modify the line containing **GRUB_CMDLINE_LINUX** as follows:

```
GRUB_CMDLINE_LINUX="cgroup_enable=memory swapaccount=1"
```

4. Update the GRUB:

```
sudo update-grub
```

5. Reboot the machine.
6. Verify that either the **/sys/fs/cgroup/memory/memory.memsw.limit_in_bytes** file or **/sys/fs/cgroup/memory/memory.soft_limit_in_bytes** file exists.

10.1.5 Enabling quota support in Linux

Quota support must be enabled so that Isolate can limit the disk usage of contestants' programs.

1. Install the kernel that support quota.

```
sudo apt-get install linux-image-extra-virtual
```

If prompted, choose "keep the local version currently installed".

2. Edit **/etc/fstab** using sudo. Iinclude **usrquota** and **grpquota** in the desired partition:

```
LABEL=cloudimg-rootfs   /    ext4   defaults,usrquota,grpquota  0 0
```

3. Reboot the machine.

4. Enable quota modules:

```
sudo depmod -a
sudo modprobe quota_v1
sudo modprobe quota_v2
sudo echo quota_v1 >> /etc/modules
sudo echo quota_v2 >> /etc/modules
```

5. Install quota package:

```
sudo apt-get install quota
```

6. Verify that quota support has been enabled. Go to **judgels-moe** directory and run:

```
obj/isolate/isolate -b1 -q50000,50 -vvv --init
```

This line must be output:

```
Quota: Set block quota 50000 and inode quota 50
```

10.1.6 Configuring Gabriel

Copy the default conf file by running this command in **judgels-gabriel** directory:

```
cp src/main/resources/conf/application_default.conf src/main/resources/conf/appl
```

Then, fill the correct configuration values in **src/main/resources/conf/application.conf**. Some guides:

gabriel.baseDataDir The root directory for performing grading. For example: **/var/judgels/data/gabriel**.

sandalphon.{baseUrl, clientJid, clientSecret} Sandalphon's base URL and the required credentials to which this Gabriel connect for fetching test cases. This Gabriel must be registered in the Sandalphon, in **Graders** menu.

sealtiel.{baseUrl, clientJid, clientSecret} Sealtiel's base URL and the required credentials to which this Gabriel connect for fetching grading requests and sending grading results. This Gabriel must be registered in the Sealtiel as a client.

moe.{isolatePath, iwrapperPath} The absolute paths to Isolate and interactive wrapper executable files, respectively.

You can use more than one Gabriel for a single Sealtiel credentials. For example, you may want to use 5 machines each containing one Gabriel for running a contest in Uriel, to make grading process fast. Simply use identical Sealtiel configuration for all Gabriels.

10.2 Manual

10.2.1 Running grader

After the installation and configuration are finished, Gabriel can be run using Activator. Run this command in **judgels-gabriel** directory:

```
./activator
```

Then, in the Activator console, run:

```
run X
```

where X is the desired number of threads. It can be omitted if you want to use default recommended number of threads based on your processor.

CHAPTER 11

Developer's guide

As Judgels is open source, we recommend anyone to contribute to Judgels development. This section is intended for getting new Judgels developers up to speed.

11.1 Basic concepts

This section will explain the basic concepts of Judgels codebase.

11.1.1 Technology stack

Language

- Java 8 for most code.
- Scala for Play's views.

Framework Play Framework 2.4.2 (Java) for Judgels Play applications.

Template engine Twirl for Judgels Play applications.

Database MySQL for Judgels Play applications.

ORM JPA (Java Persistence API) implemented with Hibernate for Judgels Play applications.

Build system SBT, wrapped in Typesafe Activator.

Sandbox Moe Contest Environment (the Isolate module) for Gabriel.

11.1.2 Project structure

Judgels repositories are hosted on GitHub, in IA TOKI organization (https://github.com/ia-toki).

The main repository is the **judgels** repository. The responisibilites of this repository are:

- Hosting Judgels command-line tool, which will be used for installing Judgels applications.

- Hosting Judgels documentation.
- Being the central GitHub issue tracker for all Judgels applications.

The other Judgels repositories are prefixed with **judgels-**. For each Judgels application <app>, there will be a repository named **judgels-<app>**, which hosts the application code.

In addition, for each Judgels applications, there will be **judgels-<app>-commons** repository, which contains parts of the application that can be used by other applications that depend on it.

judgels-commons Consists of basic dependencies used by all applications.

judgels-play-commons Mainly consists of:

- Base model components and their connection management with the database.
- Base view components that are shared across all Judgels Play applications. For example: base look-and-feel layout.
- Base controller components.

judgels-jophiel-commons Consists of components used by Jophiel clients for connecting to Jophiel.

judgels-sandalphon-commons Consists of components used by other Judgels applications for rendering problems and submitting solutions to Sandalphon.

judgels-uriel-commons Consists of components used by external applications for manipulating contest scoreboards. Currently it is not used yet by any applications other than Uriel.

judgels-sealtiel-commons Consists of components used by other Judgels applications for fetching and sending messages from Sealtiel.

judgels-jerahmeel-commons Consists of components used by other Judgels applications that depend on Jerahmeel (currently none).

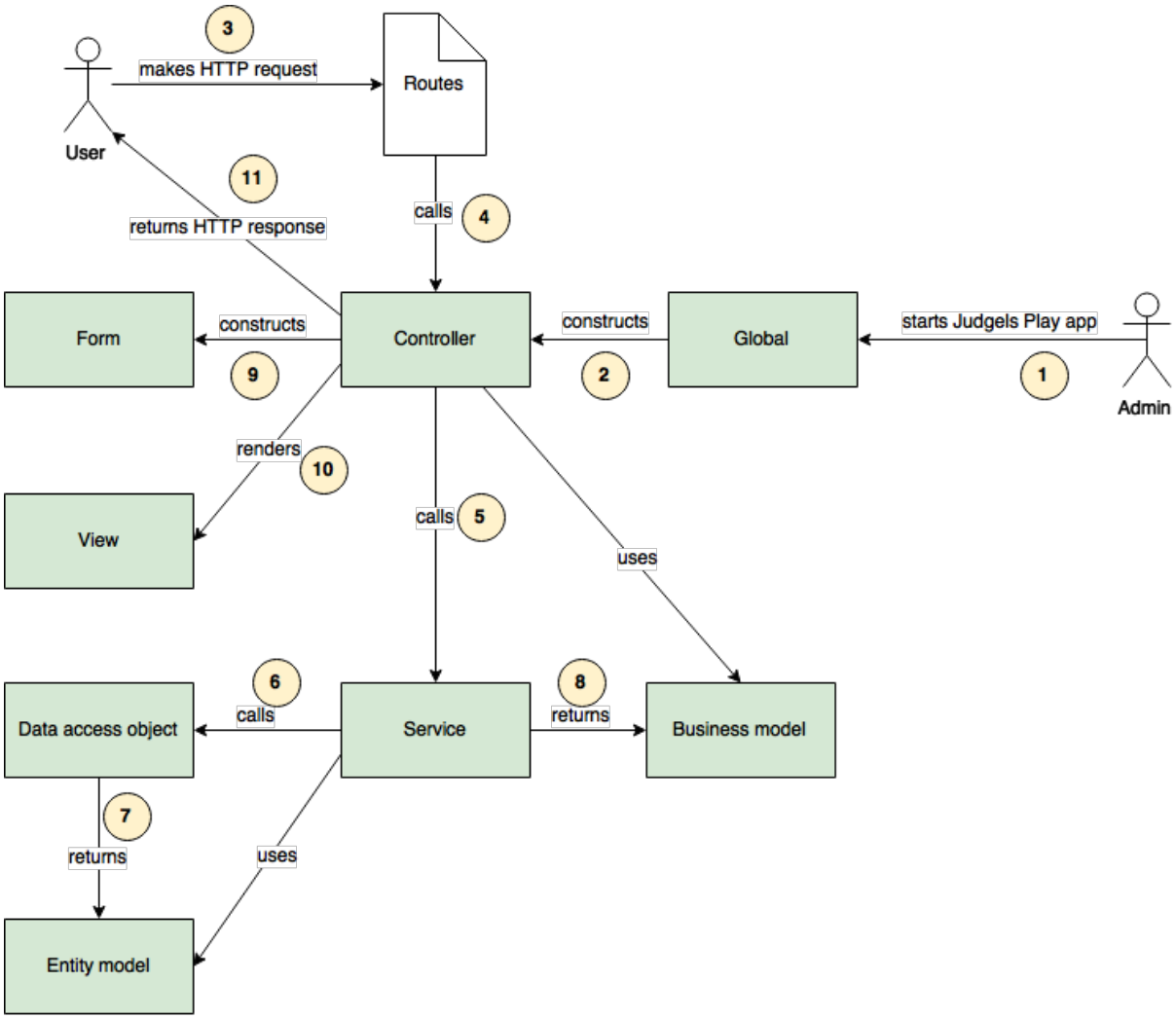
judgels-michael-commons Consists of components used by other Judgels applications that depend on Michael (currently none).

judgels-gabriel-commons Consists of interfaces and implementations of grading engines.

11.1.3 Judgels Play application layers

Judgels Play applications are built on top of Play framework. In Play framework, the MVC (Model-View-Controller) pattern is used. In Judgels, we use two other patterns: Service and DAO (Data access object).

It will be easier to explain with a diagram. Suppose that a user wants to change his profile on Jophiel. Here is the flow of events that will happen in Jophiel, numbered from 1 through 11. For completeness, we will explain from the start of Jophiel. Each component will be explained along with the explanation of the events.



1. Admin starts Jophiel, using `judgels start jophiel` or `judgels run jophiel` command.
2. The Play's Global object is loaded and run. It will construct all controller classes and their dependencies (services), using dependency injection with Spring Framework.
3. User makes HTTP request to change his profile, by opening the URL http://localhost:9001/profile on his browser.
4. The request is passed to the Play's Routes object. Based on the request string (**/profile**), the correct controller class and the action method is called. In this case, **UserProfileController**'s **profile()** method is called.
5. The controller checks whether the user has the right permission to perform the action. Then, controller calls the correct method in the service object responsible for user management. Services are objects that do business processes of the system. In this case, **UserProfileService**'s **updateProfile()** is called.
6. The service calls the DAO (Data Access Object) to retrieve the user entity model from the database. DAO is an object that provides interface to do queries to the database, regardless of the database's SQL variants. We use Hibernate for wrapping the SQL queries. In this case, **UserDao**'s **findByJid()** is called. The user's JID is passed to the method.

7. The DAO finds the correct user record in the database, wraps it into an entity model object, and return it. Entity model is the Java class representation of a row in the database table. Fields in entity model represent columns in the database table. We use JPA (Java Persistence API) for describing the table and columns in Java. In this case, the user entity model class is **UserModel**. We also use metamodels; see Syntactically correct and type-safe JPA queries in Play 2.0 for more details.
8. The service retrieves the returned user entity model, and wraps into a user business model object. This business model represent data structure that does not depend on database, and is used by controllers, views, and the other services. They do not care how the business model was constructed. In this case, the user business model class is **User**. Normally, the business model class is similar to its entity model class counterpart. Then, the user business model object is returned by the service.
9. The controller retrieves the returned user business model. Then the controller uses the user's properties to construct the form object. In this case, the form class is **UserProfileForm**.
10. The controller passes the form to the view object to render. We use Twirl, the default Play's templating engine. The whole view and form are rendered as HTML page.
11. The controller returns an HTTP response to the user. The user is then able to fill the form for changing his profile. The flow finishes.

11.1.4 Database design

Judgels adapts the database design explained here: Phabricator Database Schema. Some highlights:

- Each object in Judgels has a **JID** (Judgels ID) in the form of **JID-XXX-YYYYYYYYYYYYYYYYYY**, where X is object type code and Y is a shortened UUID.
- No foreign keys, since we want that objects can be transferred between Judgels applications. For example, we may want to create a set of Judgels instance for OSN, and then transfer the problems back to the central repository.
- Properties that are not to be queried and have complex structure, are stored either in harddisk or in database as JSON strings.

Additionally, each object has the following fields:

- userCreate, timeCreate, ipCreate: user, time, and IP when this object is created.
- userUpdate, timeUpdate, ipUpdate: user, time, and IP when this object is updated.

11.2 Workstation setup

This section will explain how developers set up their workstation to start working on Judgels development.

11.2.1 Codebase setup

Basically, you have to follow all instructions on *main Judgels setup*. Make sure you are able to run/start the Judgels applications you want to develop.

11.2.2 IDE setup

Installing IDEA

As Judgels are Java projects, you can develop Judgels using either Eclipse or IntelliJ IDEA. The Judgels maintainers recommend using IntelliJ IDEA. Download the Community edition or buy the Ultimate edition here: https://www.jetbrains.com/idea/download/ and install it.

Configuring IDEA

1. Open IDEA. You will be presented with a series of dialog boxes:

   Complete Installation Choose **I do not have a previous version of IntelliJ IDEA or I do not want to import my settings.**

   IntelliJ IDEA License Activation Enter your license key (for Ultimate edition).

   License Agreement for IntelliJ IDEA Just accept it.

   Customize IDEA Choose **Skip All and Set Defaults**.

2. The main IDEA welcome screen will appear.

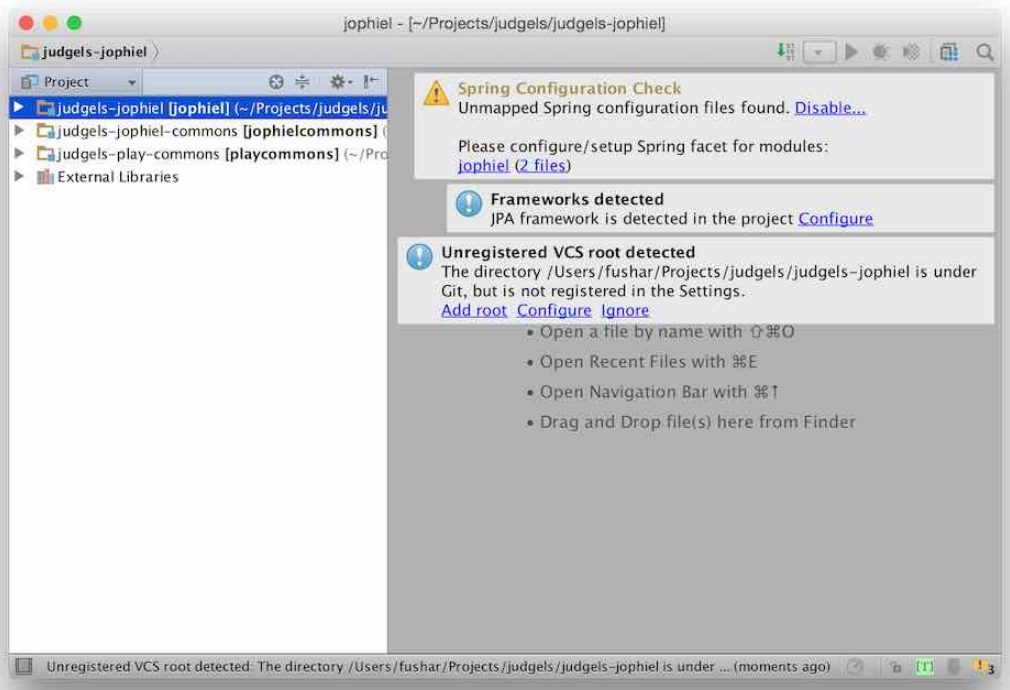
3. Click **Configure** (lower right corner) -> **Plugins**. Then, install **Scala** plugin.

IntelliJ IDEA has been successfully configured for opening Judgels projects.

Opening projects

Suppose that you want to open Jophiel project.

1. From the welcome screen, click **Open**, then select **judgels-jophiel/build.sbt** file.
2. If the **Project SDK:** dropdown is empty, click **New...** -> **JDK** beside it. Then, select your Java 8 JDK home directory.
3. Click **OK**.
4. Make sure that the Jophiel project is opened correctly. In particular, make sure that all Jophiel project dependecies are present on the projects sidebar:



5. You will notice that there are several warning boxes on the top-right corner:

   Spring Configuration Check Ignore.

   Framework detected Click **Configure**, and choose the only **persistence.xml** file.

   Unregistered VCS root detected Click **Add root**.

   These configuration are set only in the first time you open the project.

6. You can start developing.

Fixing reverse routes object error

Soon, you will notice that Play's reverse routes object is not recognized by IDEA and will be highlighted as error. This is because the reverse routes object is a generated object. To fix the false error, right-click on these directories and choose **Mark Directory As -> Generated Sources Root**.

- judgels-jophiel/target/scala-<version>/src_managed/main
- judgels-jophiel/target/scala-<version>/twirl/main

If those directories are not present, compile/run/start the application first.

If you add new routing to the **conf/routes** file, it will not be recognized by IDEA until you compile/run/start the application (because the object has not been generated yet).

11.3 Coding style

Here are some best practices that are recommended by Judgels maintainers.

11.3.1 Java

1. Use 4 spaces for indentation (not tabs).
2. Use curly braces in a block even it contains only one statement.
3. Put the opening curly brace on the right of the statement:

```
if (condition) {
    //
}
```

4. Do not use star import (`import xxx.*;`). Import individual classes.
5. Mark classes as **final** whenever possible.
6. Use Google Guava's immutable collection whenever possible.
7. Make classes immutable whenever possible. Do not introduce setters unless really required. Initialize the class properties inside the constructor.
8. Prefer this:

```
public void someFunction() {
    if (!requiredCondition1) {
        return failureMethod1();
    }

    if (!requiredCondition2) {
        return failureMethod2();
    }
```

```
        // main function code

    }
```

to:

```
    public void someFunction() {
        if (requiredCondition1) {
            if (requiredCondition2) {

                // main function code

            } else {
                return failureMethod2();
            }
        } else {
            return failureMethod1();
        }
    }
```

9. Put only statements that can really throws exception, inside a try-block. Pull the ones that don't outside.

11.4 Judgels documentation guide

This section is intended for developers that want to contribute in writing Judgels documentation.

11.4.1 Introduction

All Judgels documentation is stored in **judgels** repository, in the directory **docs**. The documentation is published on Read the Docs, here: http://judgels.readthedocs.org. The documentation will be updated every time there is a commit pushed to **judgels** repository.

The documentation is written using Sphinx. To use Sphinx, we need Python. To simplify Sphinx installation, we will use **virtualenv**.

11.4.2 Setup

1. Install Python.

   On Ubuntu:

```
    sudo apt-get install python
```

   On OS X (via **Homebrew**):

```
brew install python
```

2. Install **pip**.

   On Ubuntu:

```
sudo apt-get install python-pip
```

   On OS X: automatically installed along with Python.

3. Install **virtualenv** via **pip**:

```
pip install virtualenv
```

4. Go to main documentation directory.

```
cd $JUDGELS_BASE_DIR/judgels/docs
```

5. Create virtual environment.

```
virtualenv env
```

6. Activate the virtual environment.

```
source env/bin/activate
```

7. Install Sphinx.

```
pip install sphinx
```

Sphinx will be ready in the directory.

11.4.3 Writing documentation

First, try to build the documentation. Run

```
make html
```

If everything goes well, a file **$JUDGELS_BASE_DIR/judgels/docs/_build/html/index.html** will be built. Open it on your browser to see the documentation.

The documentation is written in **reStructuredText (RST)** syntax. The root documentation source file is **docs/index.rst**. Please consult reStructuredText Primer for more details on the syntax.

11.5 Troubleshooting

If you encounter these weird errors during development:

- no value received from a submitted form even though you have filled it correctly,
- cannot bind properties to a model,

just try to clean the project (`./activator clean`).

CHAPTER 12

Future Targets

We have some other things that we are planning for Judgels but is still in our minds and this document:

- Training Gate System

  A interactive training gate where anyone can learn about programming. The current training gate at tokilearning.org is still not friendly anough for anyone to start learning programming.

- Online Course System

  A system for academic purpose at academic institution (school, institute, university, etc). Through this system, institution can manage students by online means (like moodle). The key difference is this system support programming grading (auto grading).

- Control Panel

  Currently, Judgels system is still lack of user friendly way to control, manage and monitor running Judgels applications. Yeah, we need this.

- Forum

  We want to create forum which is integrated to Judgels where user can discuss and share anything related to Judgels. The forum can't use existing one because we need it to be integrated to Judgels.

- Drive

  Imagine when all of your source codes and your submissions is saved and tracked in online file manager. Well, that is the Drive for you.

- Editor

  The editor that can be used and integrated with Judgels system. The editor is like IDEOne, etc.