Continuous Integration with GitHub

Table of Contents

1. What for?

1.1. Continuous code verification

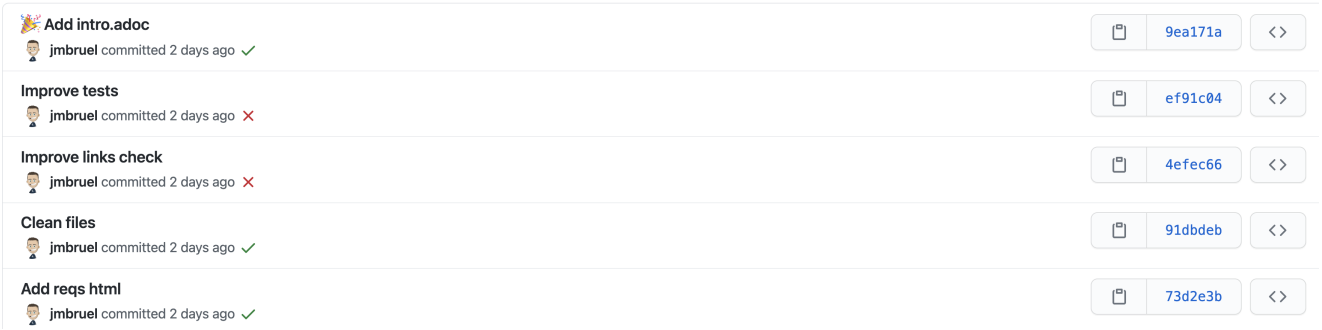


Figure 1. Traced and visible results

1.2. Environment

We illustrate here the possibilities linked with GitHub, Actions, but others can be used:

- circleci
- Jenkins (previously Hudson)
- Cruise Control
- Travis CI
- Gitlab CI

Here is a complete list: https://github.com/ligurio/awesome-ci, and here is a comparison: Wikipedia

1.3. eXtreme Programming

> Continuous Integration is a software development practice where members of a team integrate their work frequently, [...] leading to multiple integrations per day.
>
> — Martin Fowler

1.4. Principles

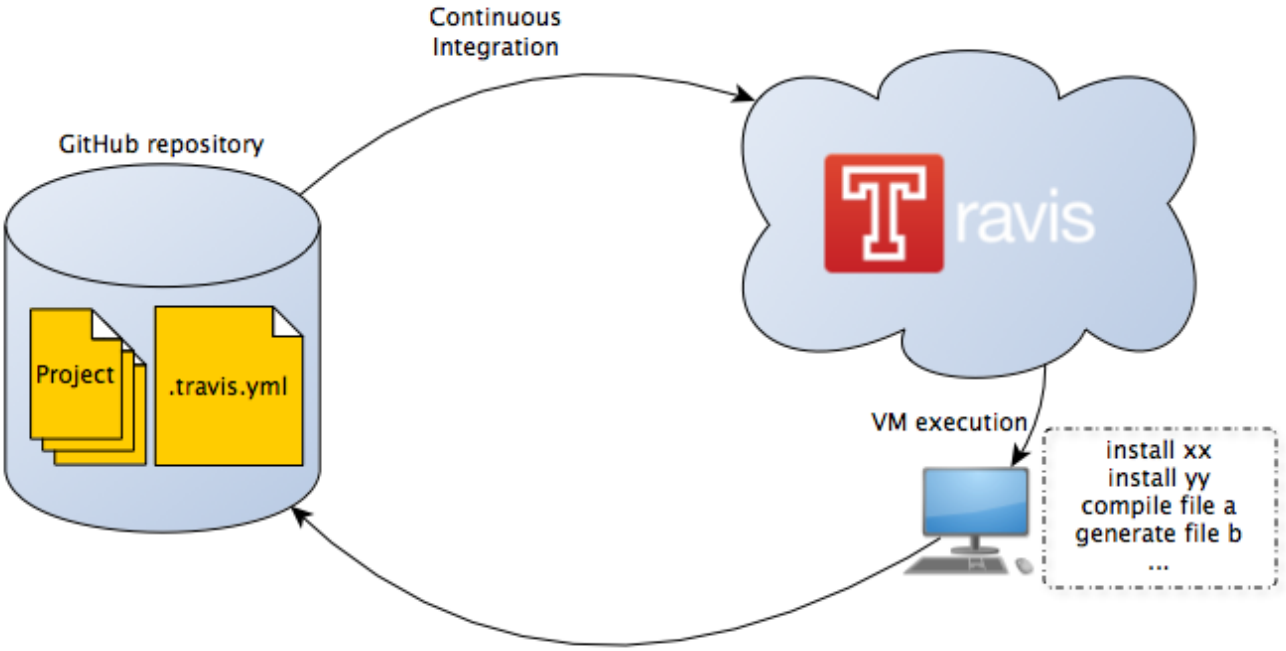


Figure 2. Typical architecture (e.g., github-travis)

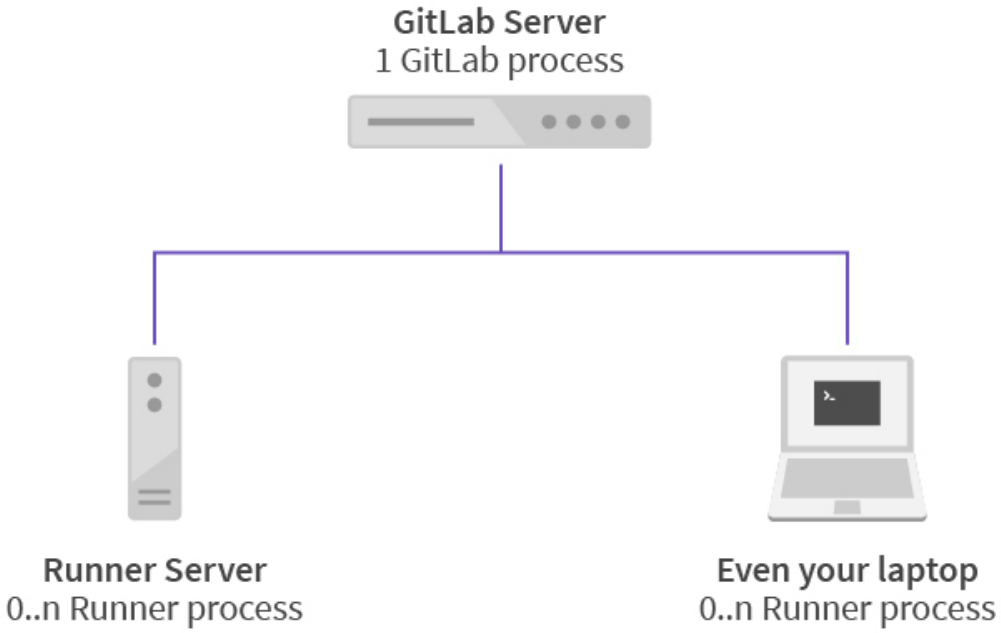


Figure 3. Architecture GitLab-CI (https://about.gitlab.com/gitlab-ci/)

1.5. YAML

YAML: **Y**AML **A**in't **M**arkup **L**anguage

Example of `.yml` file

```
---
receipt:     Oz-Ware Purchase Invoice
date:        2012-08-06
customer:
    first_name:   Dorothy
    family_name:  Gale
```

Use spaces but not tabs.

1.6. Usage

- Compile source code ⇒ **build**
- Execute **tests** suites (Junit, Audit de code source, test IHM, ...)
- Create archives
- Do some git operations (pull, checkout, push)
- Deploy code on a production machine
- Notify results (mail, RSS)
- etc.

2. Concrete illustration (GitHub)

2.1. Processus type

1. Add some specific files at a specific place
2. Describe what needs to be done in those files
3. "push" in the repo
4. Check results

2.2. Example (this repo: page generation, source: here)

```
name: Jekyll site CI ①

on: ②
  push:
    branches: [ master ]
  pull_request:
    branches: [ master ]

jobs:
  build:

    runs-on: ubuntu-latest ③

    steps:
    - uses: actions/checkout@v2
    - name: Build the site in the jekyll/builder container
      run: | ④
        docker run \
        -v ${{ github.workspace }}:/srv/jekyll -v ${{ github.workspace
}}/_site:/srv/jekyll/_site \
        jekyll/builder:latest /bin/bash -c "chmod 777 /srv/jekyll && jekyll build
--future"
```

① Name of the CI (to ckech on github)

② Specification of which branches are concerned

③ Name of the "runner" (virtual machine)

④ Instructions (here running jekyll pages generation)

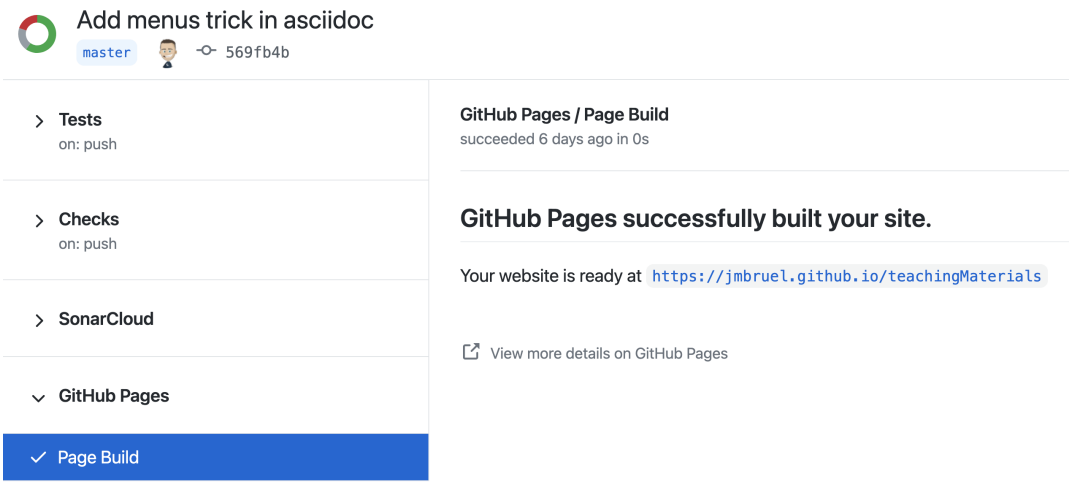


Figure 4. Result from previous script

2.3. ⚠ Danger Zone

```
image: node:4.2.2

all_tests:
  script:
   - npm install express --save
   - node ./myapp.js
```

Figure 5. Non terminating script

2.4. Solution

Here is a correct `.gitlab-ci.yml` (executing tests):

```
    - npm install express --save
    - node ./specs/start.js ./specs/async.spec.js
```

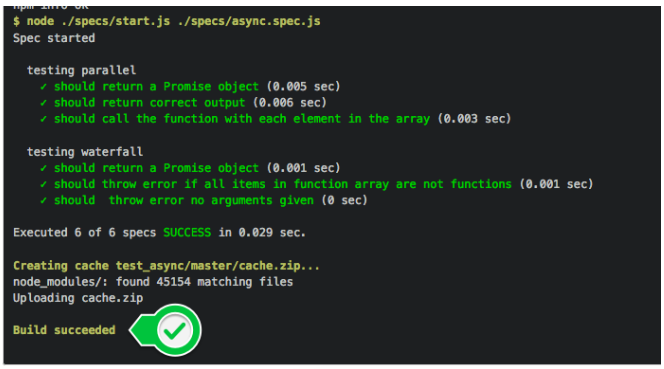


Figure 6. Build success

3. HelloWorld example

1. Java Code
2. Main to test

3. Manual Compilation
4. ant Build
5. Improvements
6. Tests
7. Eclipse
8. Continue Integration

3.1. Java code

Tutorial for ant here.

src/HelloWorld.java

```
package org.jmb;
public class HelloWorld
{
   private String name = "";
   public String getName()
   {
      return name;
   }
   public String getMessage()
   {
      if (name == "")
      {
         return "Hello!";
      }
      else
      {
         return "Hello " + name + "!";
      }
   }
   public void setName(String name)
   {
      this.name = name;
   }
}
```

3.2. Testing with a main

src/Main.java

```
package org.jmb;


public class Main {
    public static void main(String[] args) {
          org.jmb.HelloWorld h = new org.jmb.HelloWorld();
          h.setName("JMB");
          System.out.println(h.getMessage());
    }
}
```

3.3. Manual compilation

```
$ javac -sourcepath src -d bin/ src/Main.java
$ ls bin
HelloWorld.class    Main.class
$ java -cp bin Main
Hello JMB!
```

3.4. Ant build

build.xml

```
<project>
    <target name="clean">
        <delete dir="bin"/>
    </target>

    <target name="build">
        <mkdir dir="bin"/>
        <javac srcdir="src" destdir="bin"/>
    </target>

    <target name="jar">
        <mkdir dir="bin/jar"/>
        <jar destfile="bin/jar/HelloWorld.jar" basedir="bin">
            <manifest>
                <attribute name="Main-Class" value="Main"/>
            </manifest>
        </jar>
    </target>

    <target name="run">
        <java jar="bin/jar/HelloWorld.jar" fork="true"/>
    </target>

</project>
```

3.5. Manual build

```
$ ant clean build jar
$ ant run
Buildfile: /Users/bruel/HelloWorld/build.xml

run:
     [java] Hello JMB!

BUILD SUCCESSFUL
Total time: 0 seconds
```

3.6. Improvements

build.xml (improved)

```
<project name="HelloWorld" basedir="." default="main">

    <property name="src.dir"     value="src"/>
    <property name="build.dir"   value="bin"/>
    <property name="classes.dir" value="${build.dir}/classes"/>
    <property name="jar.dir"     value="${build.dir}/jar"/>

    <property name="main-class"  value="Main"/>



    <target name="clean">
        <delete dir="${build.dir}"/>
    </target>

    <target name="compile">
        <mkdir dir="${classes.dir}"/>
        <javac srcdir="${src.dir}" destdir="${classes.dir}"/>
    </target>

    <target name="jar" depends="compile">
        <mkdir dir="${jar.dir}"/>
        <jar destfile="${jar.dir}/${ant.project.name}.jar" basedir="${classes.dir}">
            <manifest>
                <attribute name="Main-Class" value="${main-class}"/>
            </manifest>
        </jar>
    </target>

    <target name="run" depends="jar">
        <java jar="${jar.dir}/${ant.project.name}.jar" fork="true"/>
    </target>

    <target name="clean-build" depends="clean,jar"/>

    <target name="main" depends="clean,run"/>

</project>
```

3.7. Manual build (improved)

```
$ ant
Buildfile: /Users/bruel/HelloWorld/build.xml

clean:
   [delete] Deleting directory /Users/bruel/HelloWorld/bin

compile:
    [mkdir] Created dir: /Users/bruel/HelloWorld/bin/classes
    [javac] Compiling 2 source files to /Users/bruel/HelloWorld/bin/classes

jar:
    [mkdir] Created dir: /Users/bruel/HelloWorld/bin/jar
      [jar] Building jar: /Users/bruel/HelloWorld/bin/jar/HelloWorld.jar

run:
     [java] Hello JMB!

main:

BUILD SUCCESSFUL
Total time: 1 second
```

3.8. Tests

src/TestHelloWorld.java (failing)

```
package org.jmb;
public class TestHelloWorld extends junit.framework.TestCase {

    public void testNothing() {
    }

    public void testWillAlwaysFail() {
        fail("An error message");
    }

}
```

build.xml (librairies extérieures)

```
<project name="HelloWorld" basedir="." default="main">

    <property name="src.dir"     value="src"/>
    <property name="build.dir"   value="bin"/>
    <property name="classes.dir" value="${build.dir}/classes"/>
    <property name="jar.dir"     value="${build.dir}/jar"/>

    <property name="main-class"  value="Main"/>
```

```
    <property name="lib.dir"     value="lib"/>

    <path id="classpath">
        <fileset dir="${lib.dir}" includes="**/*.jar"/>
    </path>

    <target name="clean">
        <delete dir="${build.dir}"/>
    </target>

    <target name="compile">
        <mkdir dir="${classes.dir}"/>
        <javac srcdir="${src.dir}" destdir="${classes.dir}"
classpathref="classpath"/>
    </target>

    <target name="jar" depends="compile">
        <mkdir dir="${jar.dir}"/>
        <jar destfile="${jar.dir}/${ant.project.name}.jar" basedir="${classes.dir}">
            <manifest>
                <attribute name="Main-Class" value="${main-class}"/>
            </manifest>
        </jar>
    </target>

    <path id="application" location="${jar.dir}/${ant.project.name}.jar"/>

    <target name="run" depends="jar">
        <java fork="true" classname="${main-class}">
            <classpath>
                <path refid="classpath"/>
                <path refid="application"/>
                <path location="${jar.dir}/${ant.project.name}.jar"/>
            </classpath>
        </java>
    </target>

    <target name="junit" depends="jar">
        <junit printsummary="yes">
            <classpath>
                <path refid="classpath"/>
                <path refid="application"/>
            </classpath>

            <batchtest fork="yes">
                <fileset dir="${src.dir}" includes="TestHelloWorld.java"/>
            </batchtest>
        </junit>
    </target>
```

```
    <target name="clean-build" depends="clean,jar"/>

    <target name="main" depends="clean,run"/>

</project>
```

3.9. Manual build (again)

```
$ ant junit
Buildfile: /Users/bruel/HelloWorld/build.xml

compile:

jar:

junit:
    [junit] Running TestHelloWorld
    [junit] Tests run: 2, Failures: 1, Errors: 0, Skipped: 0, Time elapsed: 0,003 sec
    [junit] Test TestHelloWorld FAILED

BUILD SUCCESSFUL
Total time: 1 second
```

src/TestHelloWorld.java

```
package org.jmb;
import static org.junit.Assert.*;

import org.junit.Before;
import org.junit.Test;


public class TestHelloWorldReal {

   private org.jmb.HelloWorld h;

   @Before
   public void setUp() throws Exception
   {
      h = new org.jmb.HelloWorld();
   }

   @Test
   public void testHelloEmpty()
   {
      assertEquals(h.getName(),"");
      assertEquals(h.getMessage(),"Hello!");
   }

   @Test
   public void testHelloWorld()
   {
      h.setName("World");
      assertEquals(h.getName(),"World");
      assertEquals(h.getMessage(),"Hello World!");
   }
}
```

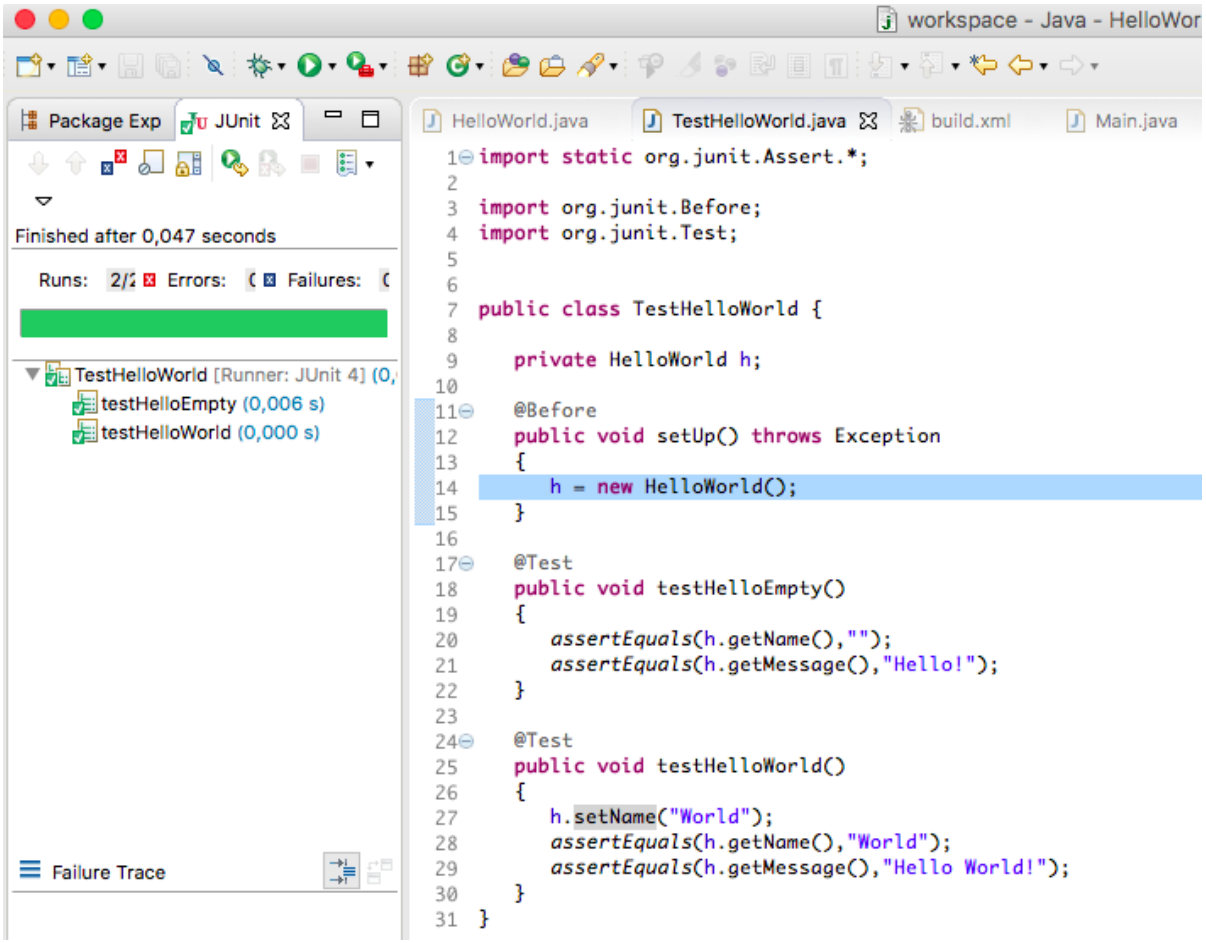


Figure 7. Test under eclipse

Do not hesitate to use the infinitest plugin.

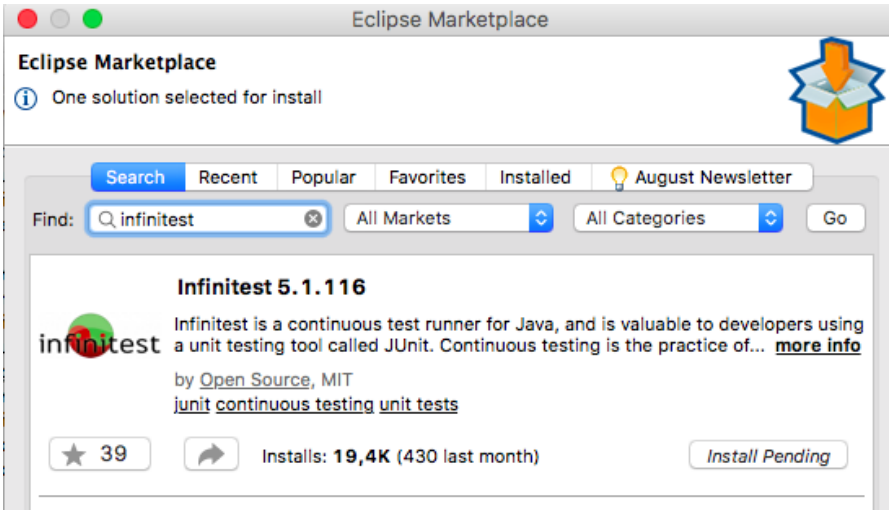


Figure 8. Infinitest plugin

3.10. Eclipse

Directly generate the build ant with Eclipse!

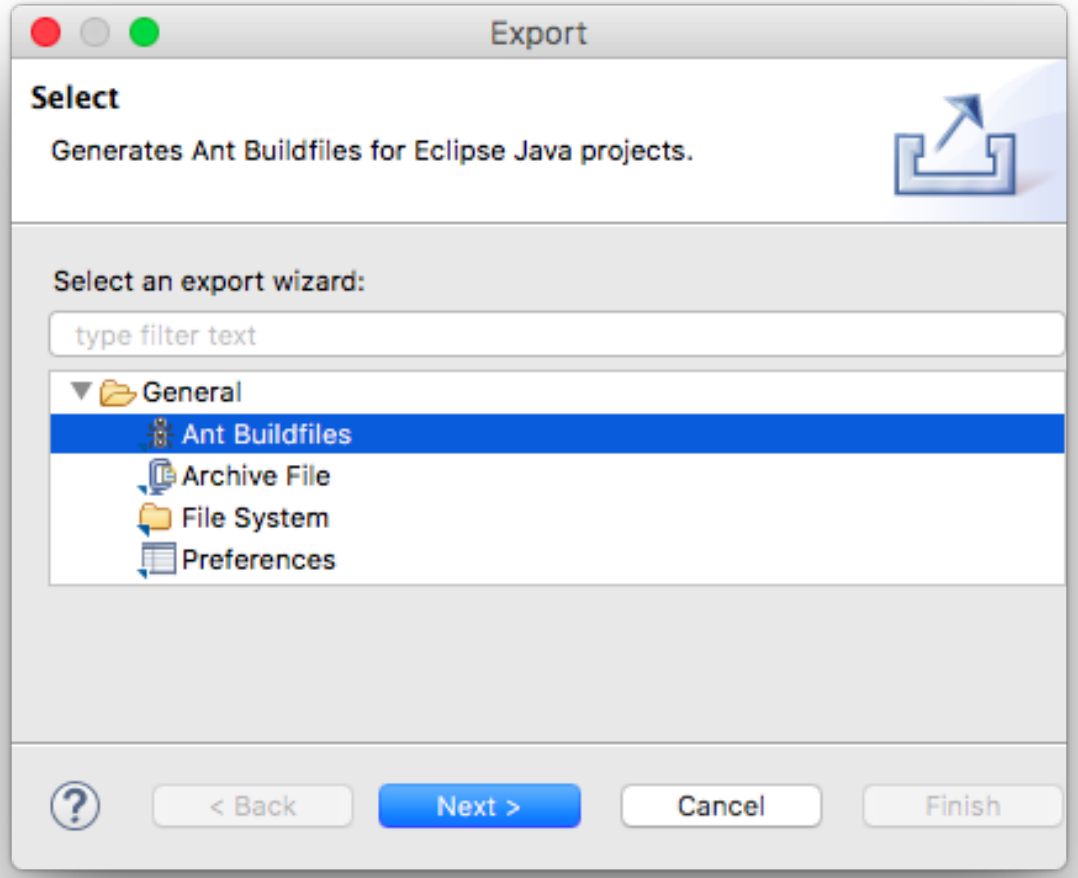


Figure 9. Export with eclipse

build.xml (export from eclipse)

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<!-- WARNING: Eclipse auto-generated file.
              Any modifications will be overwritten.
              To include a user specific buildfile here, simply create one in the same
              directory with the processing instruction <?eclipse.ant.import?>
              as the first entry and export the buildfile again. --><project
basedir="." default="build" name="HelloWorld">
    <property environment="env"/>
    <property name="junit.output.dir" value="junit"/>
    <property name="debuglevel" value="source,lines,vars"/>
    <property name="target" value="1.8"/>
    <property name="source" value="1.8"/>
    <path id="JUnit 4.libraryclasspath">
        <pathelement
location="../../../.p2/pool/plugins/org.junit_4.12.0.v201504281640/junit.jar"/>
        <pathelement
location="../../../.p2/pool/plugins/org.hamcrest.core_1.3.0.v201303031735.jar"/>
    </path>
```

```
    <path id="HelloWorld.classpath">
        <pathelement location="bin"/>
        <path refid="JUnit 4.libraryclasspath"/>
    </path>
    <target name="init">
        <mkdir dir="bin"/>
        <copy includeemptydirs="false" todir="bin">
            <fileset dir="src">
                <exclude name="**/*.launch"/>
                <exclude name="**/*.java"/>
            </fileset>
        </copy>
    </target>
    <target name="clean">
        <delete dir="bin"/>
    </target>
    <target depends="clean" name="cleanall"/>
    <target depends="build-subprojects,build-project" name="build"/>
    <target name="build-subprojects"/>
    <target depends="init" name="build-project">
        <echo message="${ant.project.name}: ${ant.file}"/>
        <javac debug="true" debuglevel="${debuglevel}" destdir="bin"
includeantruntime="false" source="${source}" target="${target}">
            <src path="src"/>
            <classpath refid="HelloWorld.classpath"/>
        </javac>
    </target>
    <target description="Build all projects which reference this project. Useful to
propagate changes." name="build-refprojects"/>
    <target name="Main">
        <java classname="org.jmb.Main" failonerror="true" fork="yes">
            <classpath refid="HelloWorld.classpath"/>
        </java>
    </target>
    <target name="TestHelloWorld">
        <mkdir dir="${junit.output.dir}"/>
        <junit fork="yes" printsummary="withOutAndErr">
            <formatter type="xml"/>
            <test name="org.jmb.TestHelloWorld" todir="${junit.output.dir}"/>
            <jvmarg line="-ea"/>
            <classpath refid="HelloWorld.classpath"/>
        </junit>
    </target>
    <target name="junitreport">
        <junitreport todir="${junit.output.dir}">
            <fileset dir="${junit.output.dir}">
                <include name="TEST-*.xml"/>
            </fileset>
            <report format="frames" todir="${junit.output.dir}"/>
        </junitreport>
    </target>
```

```
</project>
```

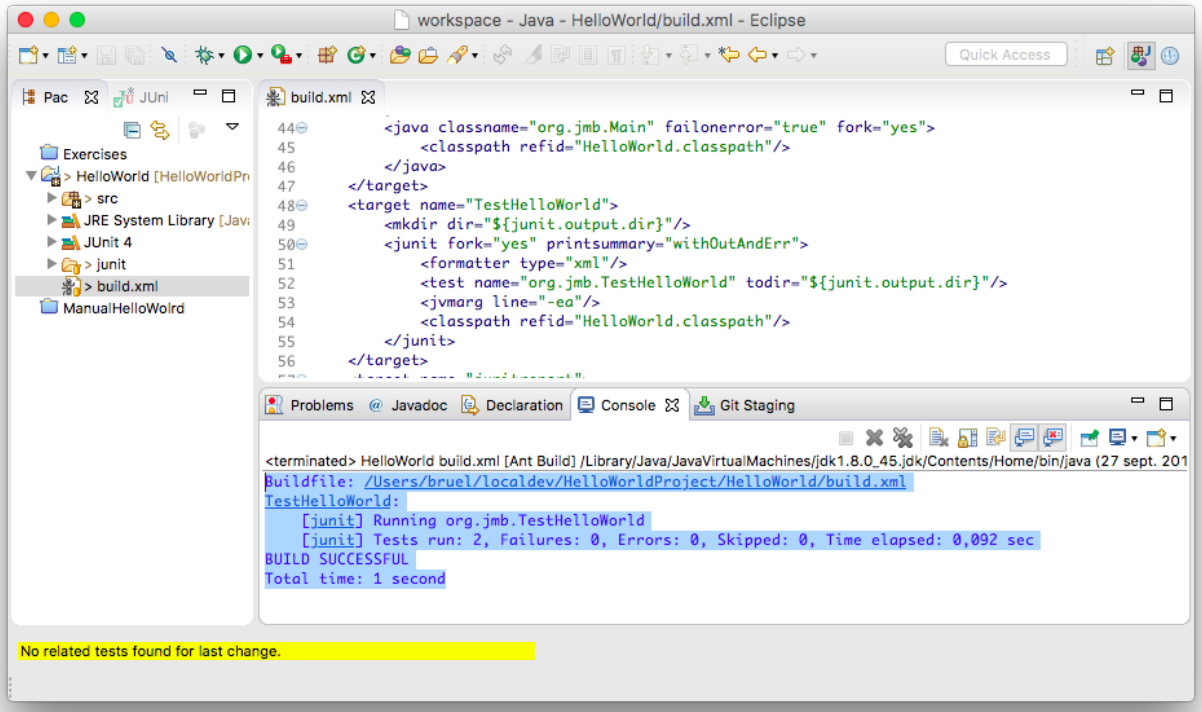


Figure 10. Run ant with eclipse

Another advantage of junit web doc generation (`junit` repo, open the `index.html` file).

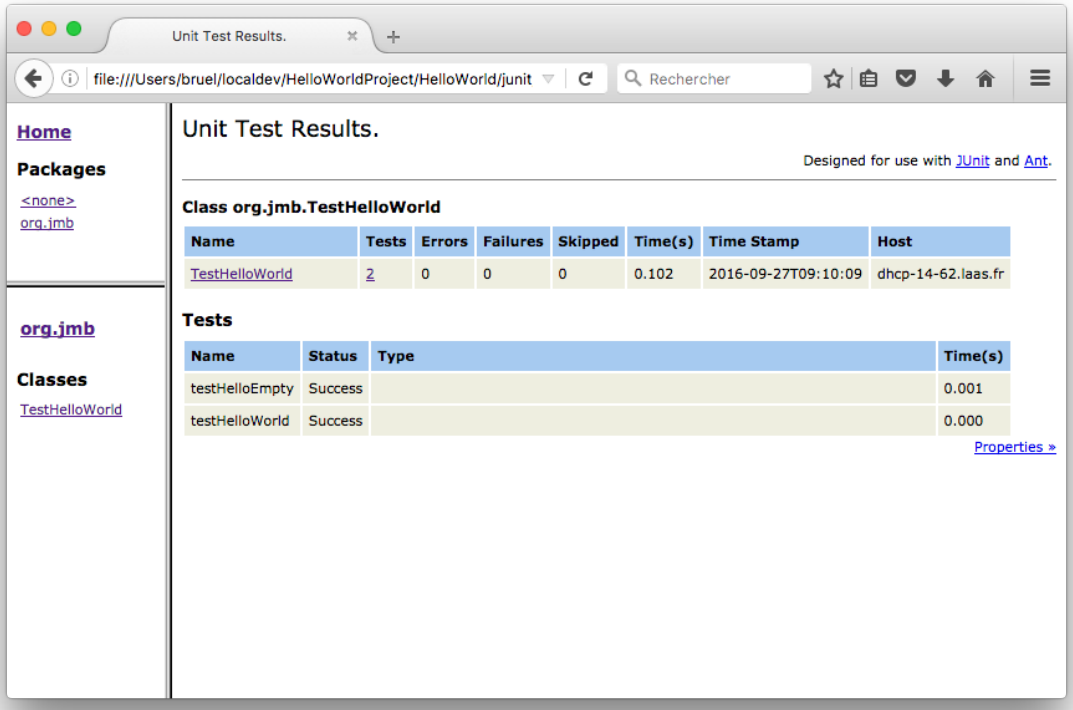


Figure 11. Testing results

3.11. Continue Integration

!.gitlab-ci.yml (added on a GitLab project)

```
image: asciidoctor/docker-asciidoctor

variables:
  GIT_SSL_NO_VERIFY: "1"

stages:
  - build
  - test

html:
  stage: build
  script:
    - asciidoctor README.adoc -o index.html
  artifacts:
    paths:
    - index.html

pdf_preview:
  stage: test
  when: manual
  environment:
    name: preview/$CI_COMMIT_REF_NAME
  except:
    - /master/
  artifacts:
    paths:
    - README.pdf
    expire_in: 1 week
  script:
    - asciidoctor-pdf README.adoc
```

The `build.xml` might have to be updated because sometimes too linked to Eclipse.

4. Tips

4.1. How NOT to run CI

```
git commit -m "Blabla... [ci skip]"
```

4.2. To check YAML syntax

https://docs.gitlab.com/ee/ci/lint.html

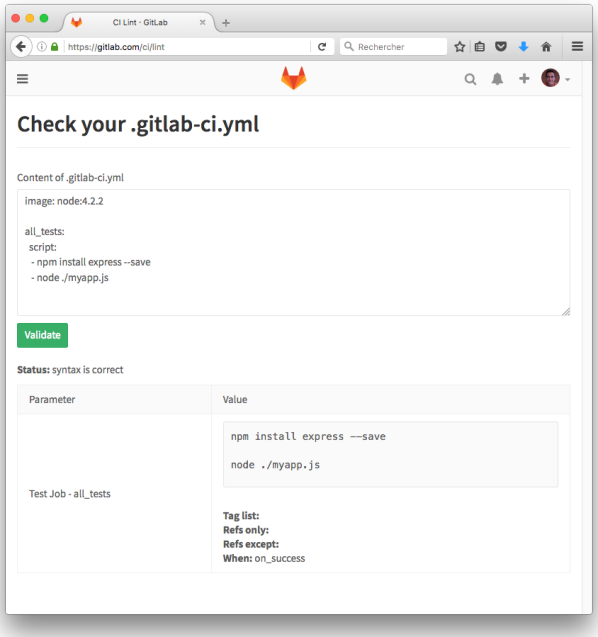


Figure 12. Check of YAML syntax

5. GitHub CI = Actions

5.1. Click and install

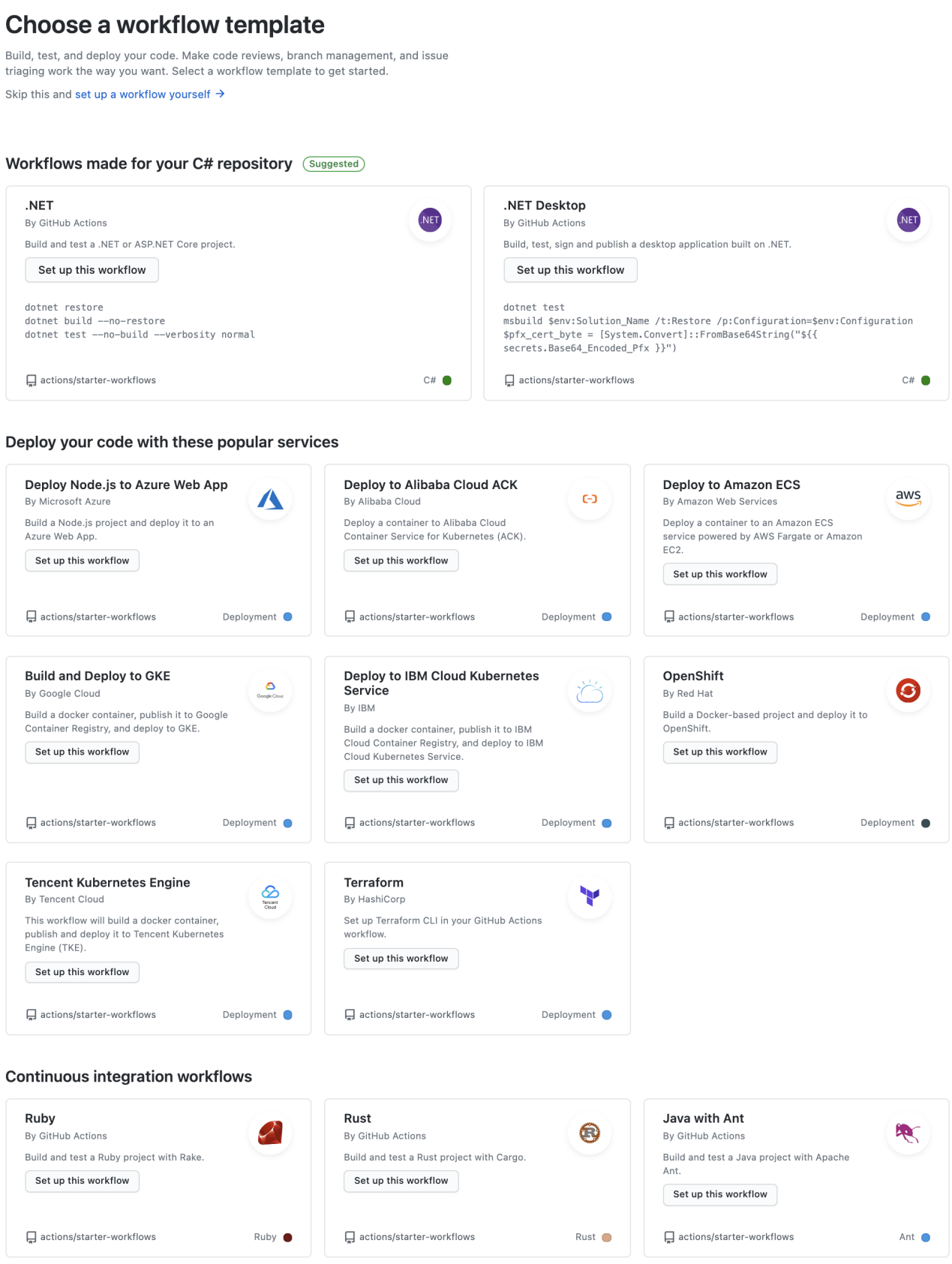


Figure 13. Choose your weapon

5.2. Lots of help and documentation

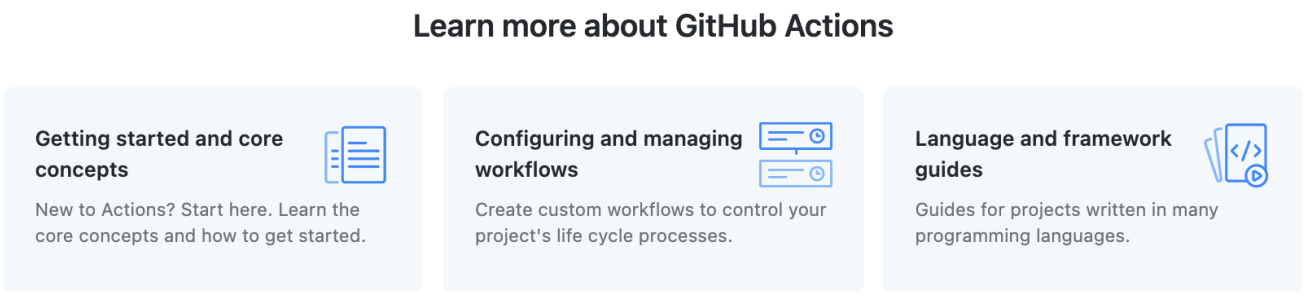
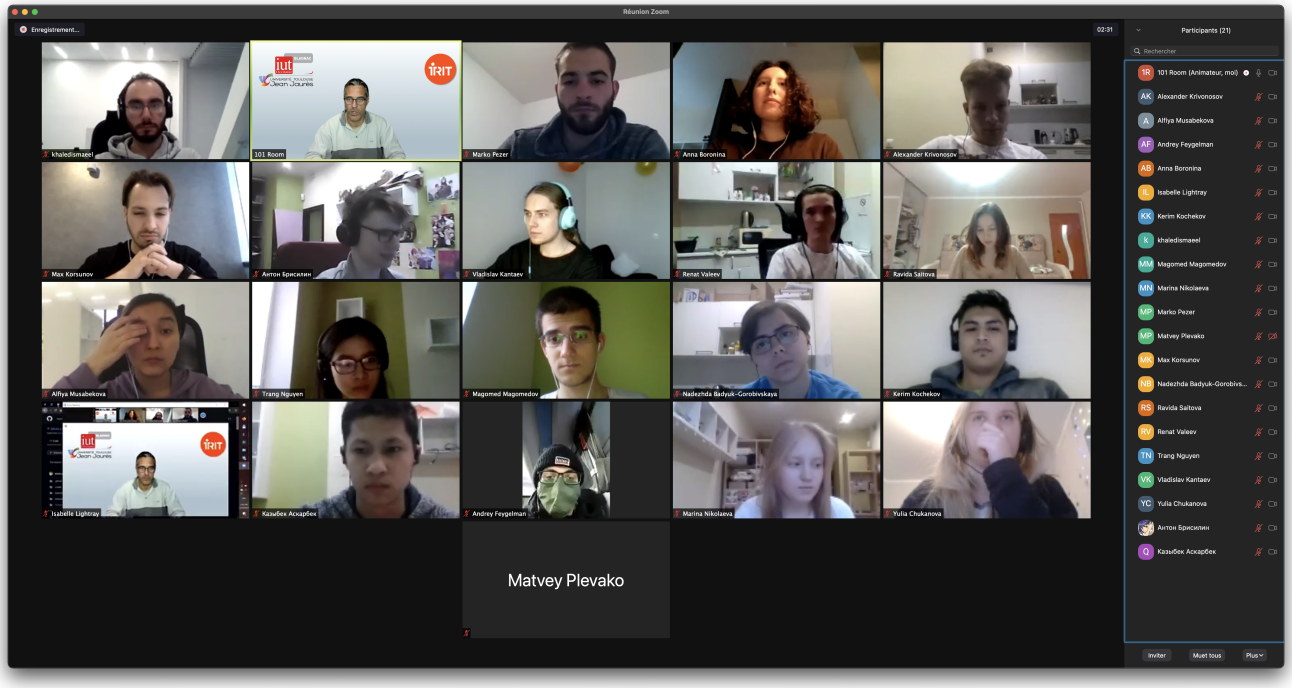


Figure 14. Tune your actions

5.3. Where to check/tune?

`.github/workflows/`

6. 2021 (awesome!) examples




```
├──── build.yml ①
├──── doxygen.yml ②
├──── linter.yml ③
├──── tests.yml ④
└──── uml.yml ⑤
```

① Build the app

② Generate documentation

③ Check code quality

④ Launch tests

⑤ Generate UML diagrams from code

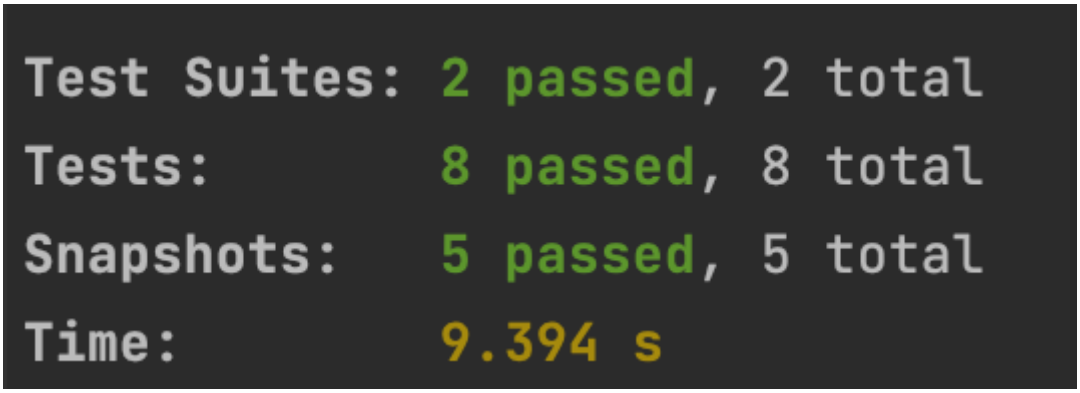


Figure 15. Tests through CI

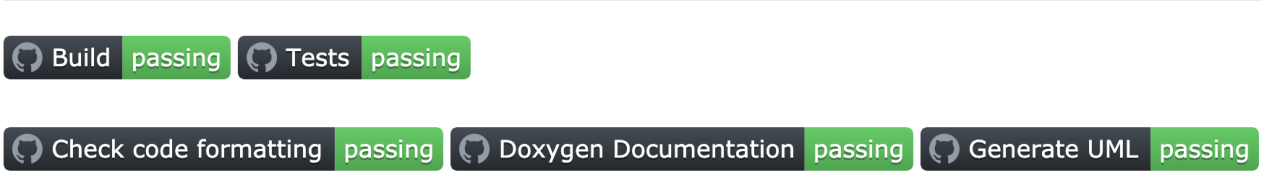


Figure 16. Easy results checking through badges

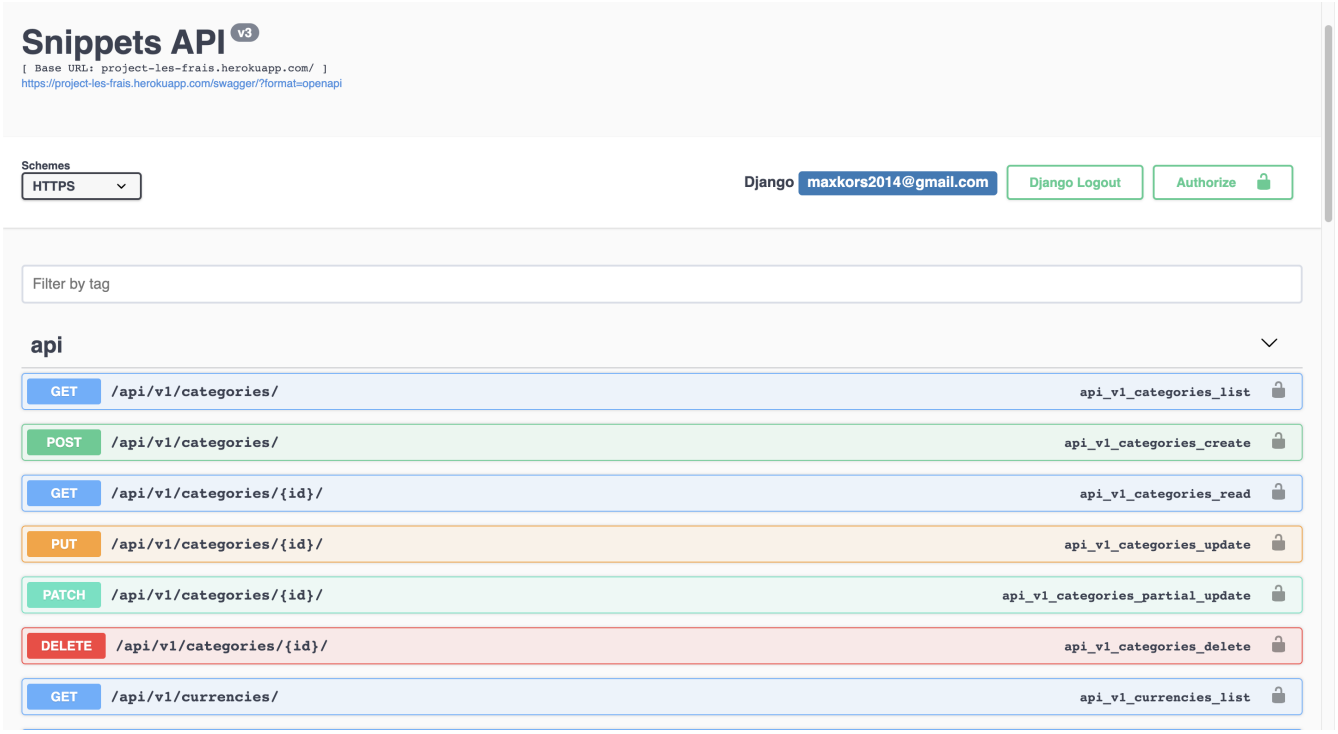


Figure 17. API documentation generation using Swagger

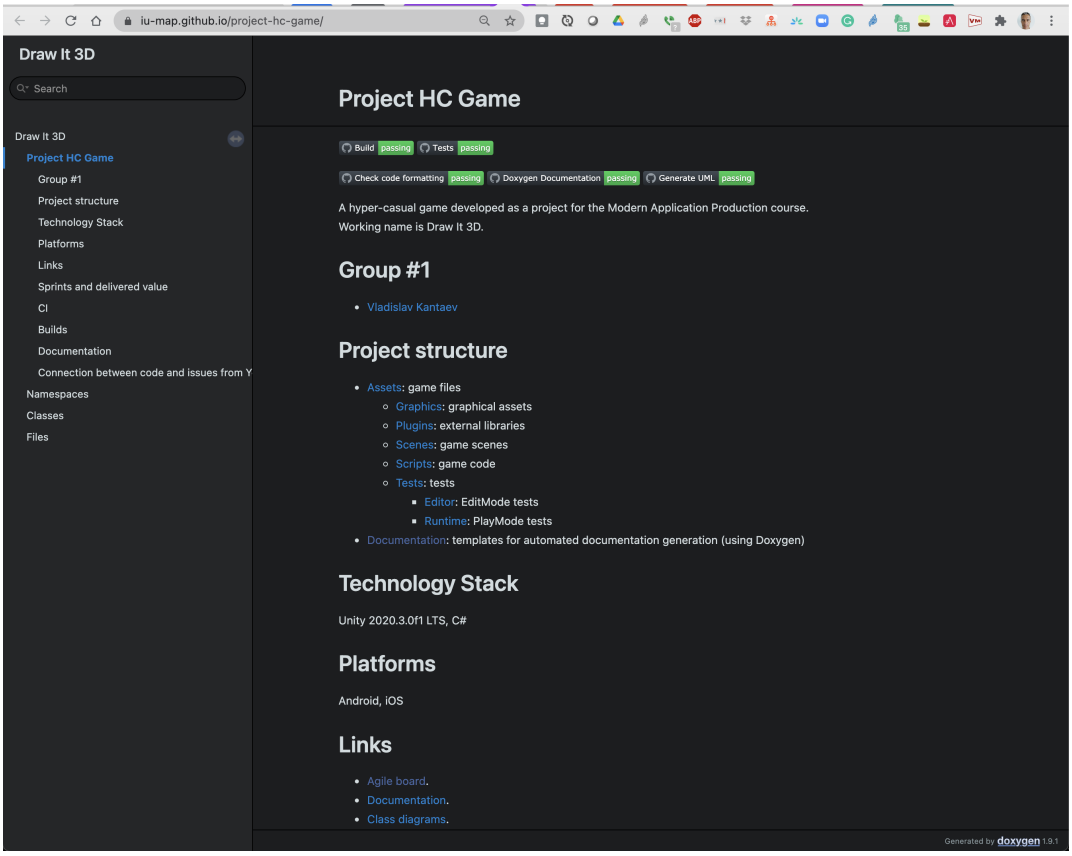


Figure 18. GitHub pages generation

7. Useful links

CI for Gitlab

Gitlab CI

CI for GitHub

Actions