

Technological foundations of software development

Master your development environment and software dependencies

Objectives of the session

Ensure that you are familiar with integrated development environments, as well as the use of dependencies on external versioned libraries.

ICM – Computer Science Major – Course unit on Technological foundations of computer science
M1 Cyber Physical and Social Systems – Course unit on CPS2 engineering and development, Part 2: Technological foundations of software development
Maxime Lefrançois <https://maxime-lefrancois.info>
online: <https://ci.mines-stetienne.fr/cps2/course/tfsd/>

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Technological foundations of software development

Master your development environment and software dependencies

Part 1: Integrated Development Environments (IDEs)

ICM – Computer Science Major – Course unit on Technological foundations of computer science
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<https://www.commitstrip.com/en/2016/05/11/the-code-ide-paradox/> CommitStrip.com

4

IntelliJ IDEA
JetBrains, 2001,
one of the best Java IDEs starting 2010
written in **Java** and **Kotlin**
Community ed. Apache License 2.0 - Open source
Paid version - Trialware

NetBeans
Student (1996),
then Sun Microsystems (1999),
then Oracle Corporation (2010),
then Apache Software Foundation (2016)
written in **Java**
Apache License 2.0 - Open source

Eclipse
IBM (2001),
then Eclipse Foundation (2004)
written in **Java, C**
Eclipse Public License - Open source

Eclipse Che and Codenvy
Eclipse Foundation (2016),
Cloud-based IDE
written in **Java, Google Web Toolkit, Docker**
Eclipse Public License - Open source

<https://www.slant.co/topics/607/~best-java-ides-or-editors>

Slant What are the best... Log in · Sign up ADD QUESTION

DEVELOPMENT JAVA IDE FOLLOW ...

What are the best Java IDEs or editors?

15 OPTIONS CONSIDERED 711 USER RECS Sep 9, 2021 LAST UPDATED

Visual Studio Code
Microsoft (2015)
written in **TypeScript, JavaScript, HTML, CSS**
MIT License - Open source

THE BEST OF 12 OPTIONS WHY?

	BEST JAVA IDES OR EDITORS	PRICE	PLATFORMS	AUTO COMPLETE
93	IntelliJ IDEA	FREE / PAID	Windows, Linux, Mac	-
84	NetBeans	FREE	Windows, macOS, Linux	Yes
77	Visual Studio Code	FREE	Windows, macOS, Linux	Yes
64	Eclipse Che	FREE	Windows, Linux, Mac	-
...	Codenvy	-	Browser-Based	Yes

IntelliJ IDEA
JetBrains, 2001,
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Community ed. Apache License 2.0 - Open source
Paid version - Trialware

NetBeans
Student (1996),
then Sun Microsystems (1999),
then Oracle Corporation (2010),
then Apache Software Foundation (2016)
written in **Java**
Apache License 2.0 - Open source

Android Studio
Google, JetBrains, 2013
Based on IntelliJ IDEA
freeware

<https://www.slant.co/topics/1321/~best-ides-for-android-development>

Slant What are the best... Log in · Sign up ADD QUESTION

DEVELOPMENT ANDROID FOLLOW ...

What are the best IDEs for Android development?

15 OPTIONS CONSIDERED 884 USER RECS 7 mins LAST UPDATED

Visual Studio Code
Microsoft (2015)
written in **TypeScript, JavaScript, HTML, CSS**
MIT License - Open source

THE BEST OF 14 OPTIONS WHY?

	BEST IDES FOR ANDROID DEVELOPMENT	PRICE	PLATFORMS	LATEST VERSION
93	IntelliJ IDEA	FREE / PAID	Windows, Linux, Mac	-
90	Android Studio	FREE	-	3.6 (Stable), 3.6 RC 3 (Preview)
82	NetBeans IDE	-	Windows, Linux, Mac, BSD	-
...	Visual Studio Code	FREE	Windows, macOS, Linux	-
...	JetBrains Rider	-	-	-

WebStorm
JetBrains, 2001,
written in **Java** and **Kotlin**
Community ed. Apache License 2.0 - Open source
Paid version - Trialware
WebStorm - For web, JavaScript and TypeScript development. Many of JetBrains's other IDEs include the feature set of WebStorm via plugins.

Vim
Bram Moolenaar (1991)
written in **C**
Vim License - Open source
<https://blog.talainlabs.com/vim-cest-bien-mais-vscode/>

Atom
GitHub (2014)
written in **CoffeeScript, JavaScript, Less, HTML**
MIT License - Open source

Sublime Text
Jon Skinner (2008)
written in **C++, Python**
Proprietary License

<https://www.slant.co/topics/46/~best-ides-for-node-js>

Slant What are the best... Log in · Sign up ADD QUESTION

DEVELOPMENT PRODUCTIVITY FOLLOW ...

What are the best IDEs for Node.js?

23 OPTIONS CONSIDERED 1K USER RECS 43 mins LAST UPDATED

Visual Studio Code
Microsoft (2015)
written in **TypeScript, JavaScript, HTML, CSS**
MIT License - Open source

THE BEST OF 19 OPTIONS WHY?

	BEST IDES FOR NODE.JS	PRICE	PLATFORMS	MULTI LANGUAGE SUPPORT
90	WebStorm	-	Windows; macOS; Linux	Yes
89	Visual Studio Code	FREE	Windows, macOS, Linux	Yes
87	Vim	-	Linux, macOS, Windows	-
76	Atom	-	macOS, Linux	Yes
...	Sublime Text	\$70	Windows; macOS; Linux	Yes

PyCharm
JetBrains, 2001,
written in **Java** and **Python**
Community ed. Apache License 2.0 - Open source
Paid version - Trialware
WebStorm - For web, JavaScript and TypeScript development. Many of JetBrains's other IDEs include the feature set of WebStorm via plugins.

Vim
Bram Moolenaar (1991)
written in **C**
Vim License - Open source
<https://blog.talainlabs.com/vim-cest-bien-mais-vscode/>

Spyder
Puiere Raybaut (2009)
written in **Python**
MIT License - Open source

Sublime Text
Jon Skinner (2008)
written in **C++, Python**
Proprietary License

<https://www.slant.co/topics/1332/~best-free-ides-for-python>

Slant What are the best... Log in · Sign up ADD QUESTION

DEVELOPMENT PRODUCTIVITY PYTHON FOLLOW ...

What are the best free IDEs for Python?

23 OPTIONS CONSIDERED 552 USER RECS Sep 24, 2021 LAST UPDATED

Visual Studio Code
Microsoft (2015)
written in **TypeScript, JavaScript, HTML, CSS**
MIT License - Open source

THE BEST OF 23 OPTIONS WHY?

	BEST FREE IDES FOR PYTHON	PRICE	PLATFORMS	AUTO COMPLETE
91	PyCharm Community E..	-	-	-
88	Vim	FREE	Linux, macOS, Windows	-
...	Visual Studio Code	FREE	Windows, macOS, Linux	Yes
79	Spyder	-	-	Yes
...	Spacemacs with Pytho...	-	Windows, Unix, Mac	Yes

Arduino IDE
 Arduino Software, 2005,
 Written in **C and C++**
 GNU General Public License 2 - Open source

PlatformIO
 Ivan Kravets, 2014
 Not an IDE – just a CLI + extensions
 Written in **Python**
 Useable as a plugin for:
 - VSCode
 - Eclipse
 - Netbeans
 - Atom
 - Sublime Text
 - ...

<https://www.slant.co/topics/9848/?arduino-ide-alternatives>

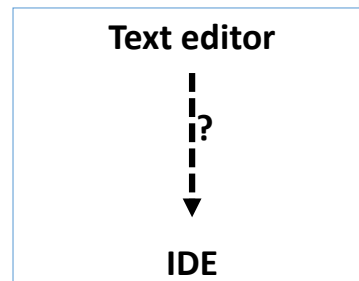
What are the best Arduino IDE alternatives?

8 OPTIONS CONSIDERED 317 USER RECS Sep 30, 2021 LAST UPDATED

THE BEST 1 OF 7 OPTIONS WHY?

BEST ARDUINO IDE ALTERNATIVES	PRICE	PLATFORMS	LICENSE
91 CodeBlocks	-	-	-
Geany	FREE	Windows; OSX; *nix	GPL
62 platformio	FREE	-	-
Netbeans with Arduino ...	-	-	-
Emacs	-	Unix-like, Windows	GPL

A large number of programming languages,
 A large number of IDEs



<https://www.slant.co/topics/9848/?arduino-ide-alternatives>

What are the best IDEs for C++ on Linux?

What are the best IDEs for C++ on Mac OS X?

What are the best IDEs for Node.js?

What are the best IDEs for Android development?

What are the best IDEs for C++ on Windows?

What are the best IDEs for the Go programming language?

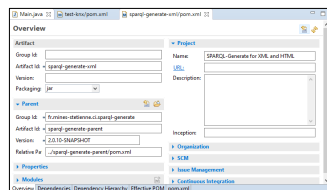
Can't find what you're looking for?

ADD QUESTION

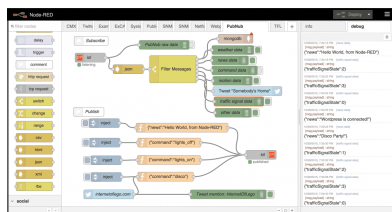
90	WebStorm	-	Windows; macOS; Linux	Yes
89	Visual Studio Code	FREE	Windows; macOS; Linux	Yes
87	Vim	-	Linux; macOS; Windows	-
76	Atom	-	macOS; Linux	Yes
	Sublime Text	\$70	Windows; macOS; Linux	Yes

Types of IDEs

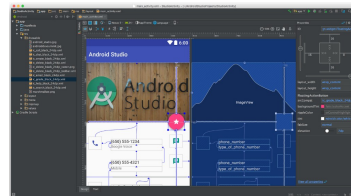
Visual programming



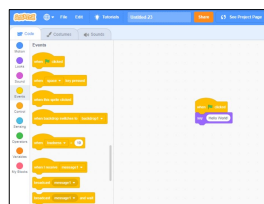
Formulaire to edit an XML document in Eclipse



Visual programming with Node-RED



Interface programming with Android Studio



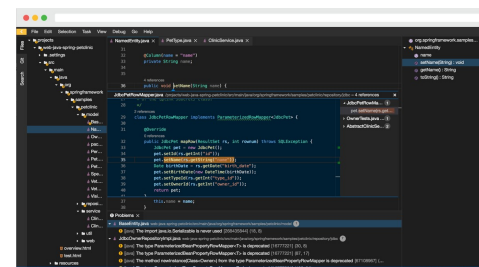
Visual programming for learning to program with Scratch

Types of IDEs

Web IDE

Actually to produce code

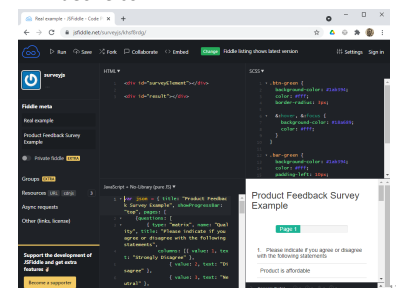
- Eclipse Che
- CodeAnywhere
- Replit
- Cloud9 IDE



Eclipse Che

Playgrounds and snippet sharing

- codesandbox.io
- codechef.com
- jsfiddle.com
- ideone.com

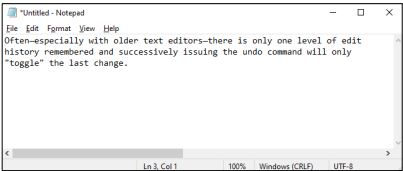


jsfiddle

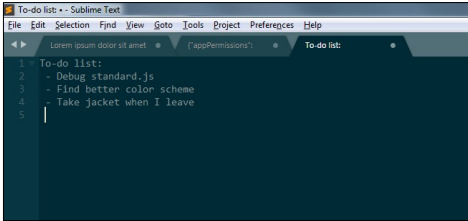
Text editors features

Undo- redo

- Stack of edits
- Unsaved changes



Stupid Undo – Redo with Notepad

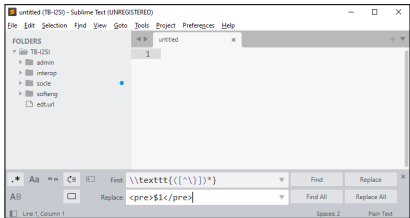


Unsaved files are available when you reopen Sublime Text

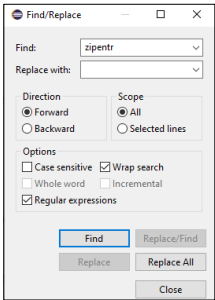
Text editors features

Find- Replace

- In file or set of files
- With REGEX - Regular expressions



Find – Replace with Sublime Text



Find – Replace with Eclipse



Find – Replace with IntelliJ IDEA

regex cheatsheet

Character classes

.	Any character, except newline
\w	Word
\d	Digit
\s	Whitespace
\W	Not word
\D	Not digit
\S	Not whitespace
[a-e]	Any of a, b, or c
[1-9]	Digit between 1 and 9
[[:print:]]	Any printable character including spaces
[^abc]	Any character except a, b or c

Anchors

\G	Start of match
^	Start of string
\$	End of string
\A	Start of string
\Z	End of string
\b	A word boundary
\B	Non-word boundary
^abc	Start with abc
abc\$	End with abc

Lookahead & Lookbehind

a(?b)	Match a in baby but not in bay
a(?B)	Match a in Stan but not in Stab
(?<=a)b	Match b in crabs but not in cr1bs
(?<=a)b	Match b in f1b but not in Fab

Escaped characters

\.	Escape special character used by regex
\t	Tab
\n	Newline
\r	Carriage return

Groups

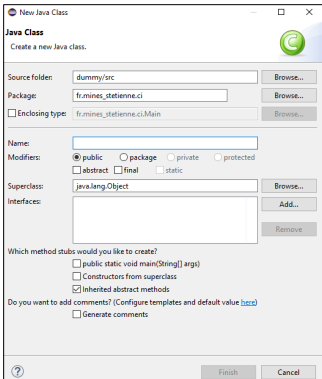
(abc)	Capture group
(a b)	Match a or b
(?:abc)	Match abc, but don't capture

Quantifiers

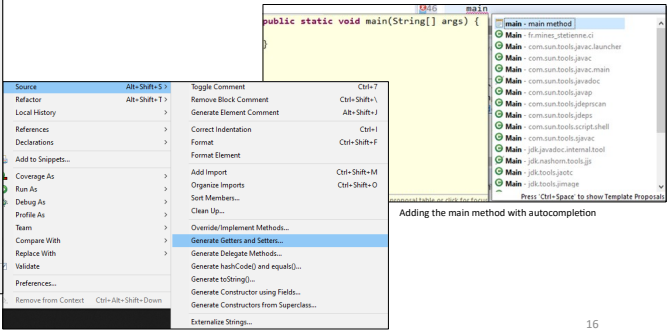
a*	Match 0 or more
a+	Match 1 or more
a?	Match 0 or 1
a(5)	Match exactly 5
a{,3}	Match up to 3
a{3,}	Match 3 or more
a{1,3}	Match between 1 and 3

Text editors features

Source code generation snippets



File creation form



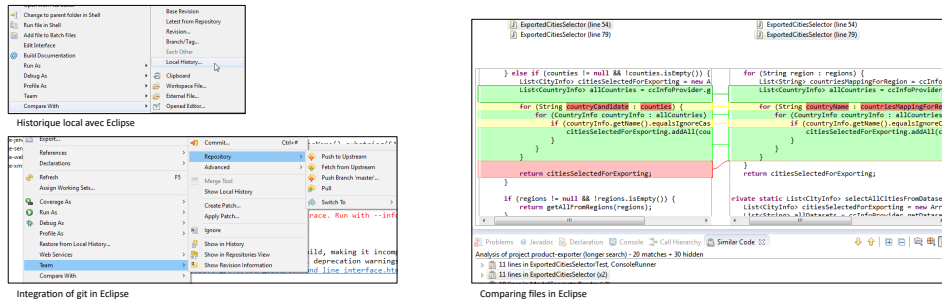
Adding the main method with autocompletion

Generation of frequent methods getters, setters, hashCode, equals, etc.

IDE features

Version control and file comparison

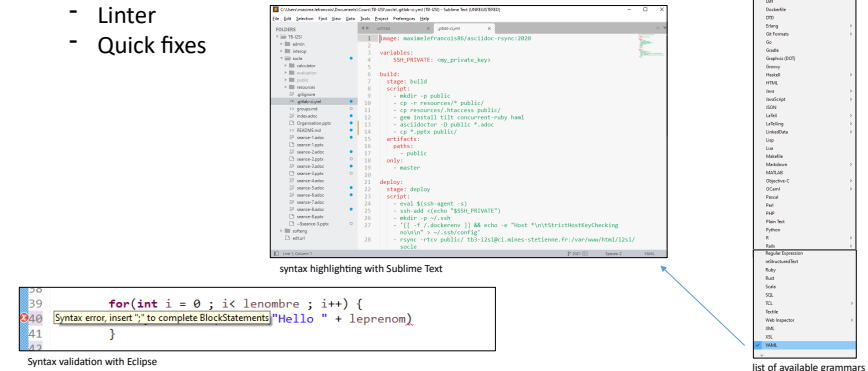
- Local history,
- Version Control System (VCS) integration
- File comparison utilities



IDE features

Syntax highlighting and validation

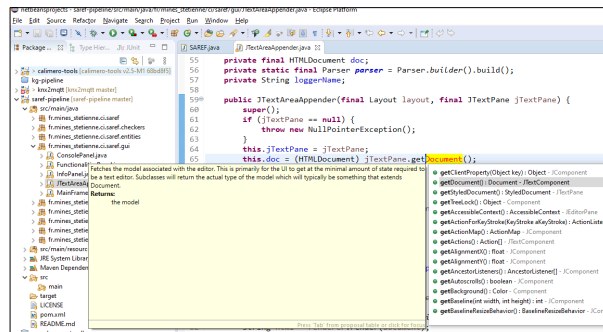
- Warnings and errors
- Linter
- Quick fixes



IDE features

Code completion

- More or less intelligent
- Based on current project or external libraries

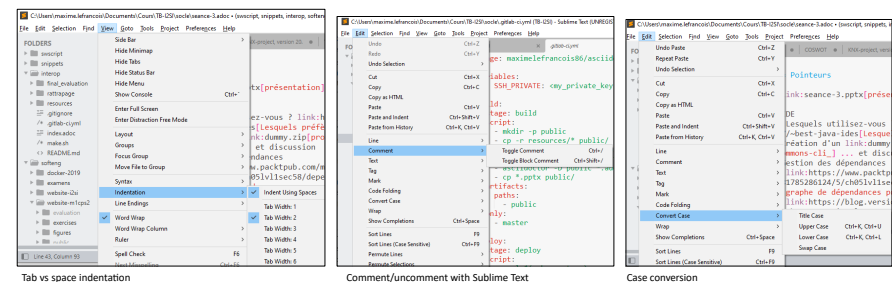


CTRL+SPACE: Auto-completion with Eclipse

IDE features

Text formatting

- Automatic line feed
- Auto-indentation tab/space
- Comment/uncomment



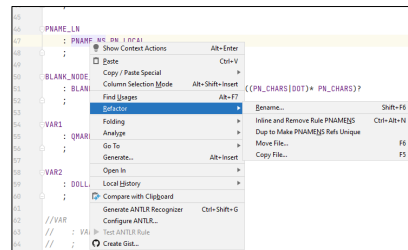
Tab vs space indentation

Comment/uncomment with Sublime Text

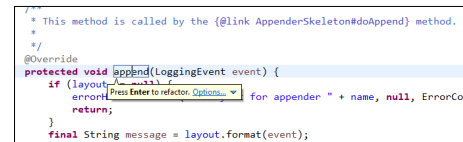
Case conversion

IDE features Refactoring

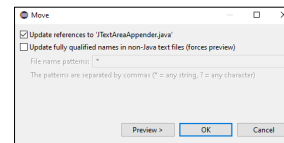
- Replacement of an identifier in the whole project
- identifier of variable, method, class, ...
- Change package of a java class, ...



Refactoring with IntelliJ: SHIFT+F6



in line refactoring with Eclipse: ALT+SHIFT+R

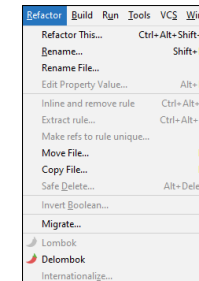


moving a Java class with Eclipse

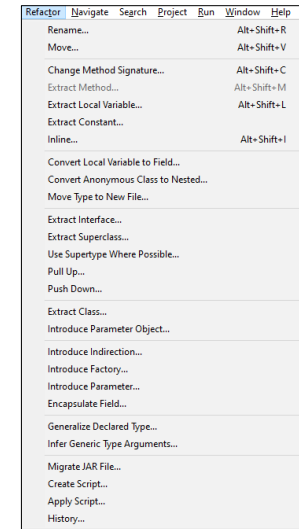
21

IDE features Refactoring

- Replacement of an identifier in the whole project
- identifier of variable, method, class, ...
- Change package of a java class, ...



Refactor menu in IntelliJ

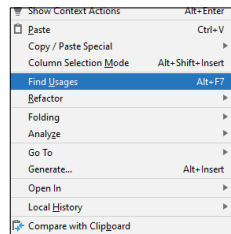


Refactor menu in Eclipse

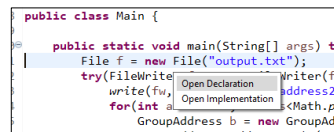
22

IDE features Analysis and Navigation

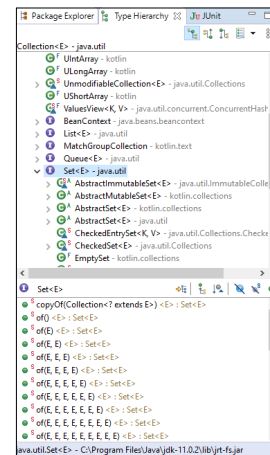
- CTRL+click to navigate to the declaration
- Viewing the hierarchy, viewing the members



IntelliJ - Find usages - ALT+F7



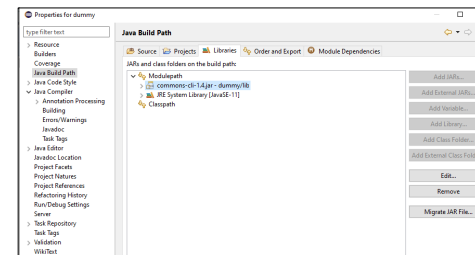
CTRL to display the navigation options



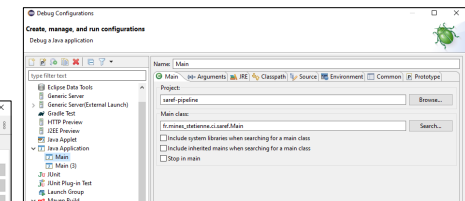
Eclipse Source Hierarchy and navigator pane - open for a class with F4

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IDE features Project configuration



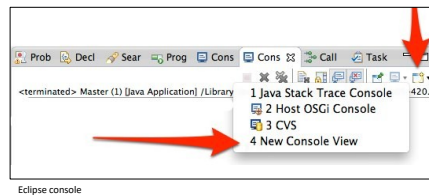
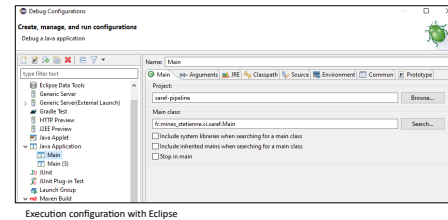
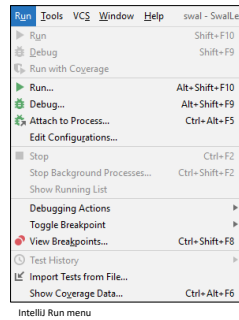
Add an external library to a java project in Eclipse



Execution configuration with Eclipse

24

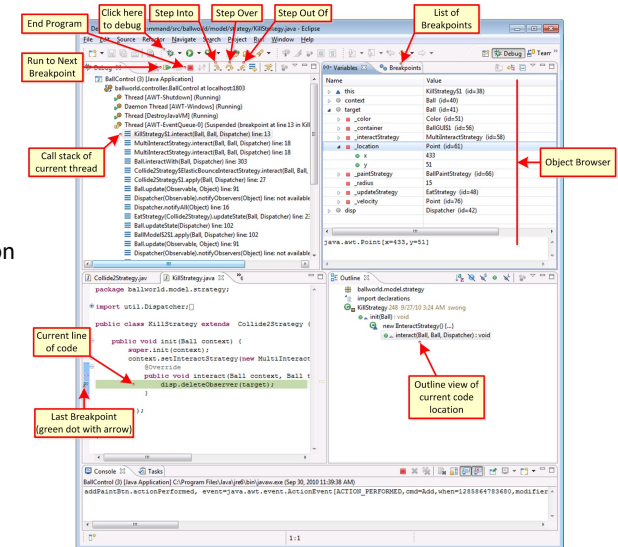
IDE features Run



25

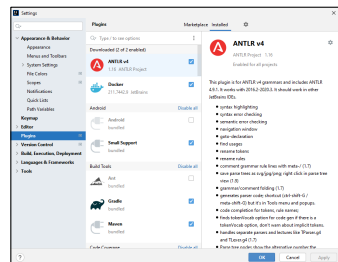
IDE features Debug

- Controlled execution of the program
- Monitoring and/or modification of the content of variables during execution
- Allows to trace bugs

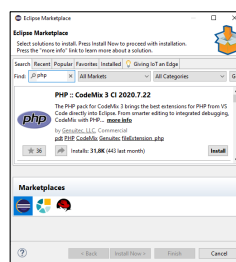


IDE features Extensibility

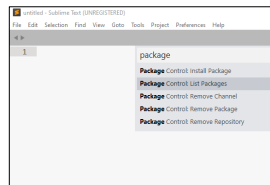
- Extension system, plugins, packages, ...



IntelliJ IDEA plugins

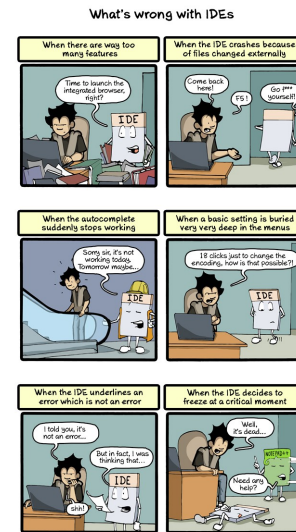


Eclipse Marketplace



Packages control in Sublime Text -> tool -> command palette

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<https://www.commitstrip.com/en/2015/04/22/whats-wrong-with-ides/> CommitStrip.com

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Technological foundations of software development

Master your development environment and software dependencies

Part 2: Versioned external libraries

ICM – Computer Science Major – Course unit on Technological foundations of computer scienceopment
M1 Cyber Physical and Social Systems – Course unit on CPS2 engineering and development, Part 2: Technological foundations of software development
Maxime Lefrançois <https://maxime-lefrancois.info>
online: <https://ci.mines-stetienne.fr/cps2/course/tfsd/>

External libraries

- Set of resources that can be reused
 - sources
 - compiled code
 - documentation

[https://en.wikipedia.org/wiki/Library_\(computing\)](https://en.wikipedia.org/wiki/Library_(computing))

30

External libraries

- Set of resources that can be reused
 - sources
 - compiled code
 - documentation
- Used in different phases of the software life cycle
 - For compilation (static library, *.lib, *.a)
 - For testing
 - For execution (dynamic library, *.dll, *.so)
 - At runtime (OSGi example)

[https://en.wikipedia.org/wiki/Library_\(computing\)](https://en.wikipedia.org/wiki/Library_(computing))

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Linking

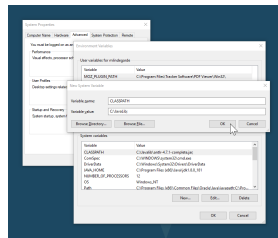
- Resolution phase of references to external libraries
- Static linking
 - copy the *.lib or *.a library during the creation of the executable
 - pro: more portable, no version conflicts
 - con: copy **the whole library** -> not optimized
- Dynamic linking
 - resolution and loading of the library at runtime
 - pro: save disk and memory space,
 - pro: in case of bug, just replace the *.dll or *.so
 - con: **DLL hell**: evolution and backward compatibility problems

[https://en.wikipedia.org/wiki/Library_\(computing\)](https://en.wikipedia.org/wiki/Library_(computing))

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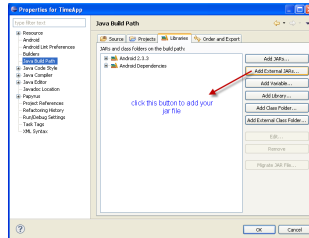
With Java – class libraries

- The *Class Loader* resolves references with the Classpath
 - Compiled classes *.class, or archives *.jar
 - CLASSPATH environment variable
 - jvm option - -classpath



Classpath environment variable

<https://docs.oracle.com/javase/8/docs/technotes/guides/jvms/5.html>

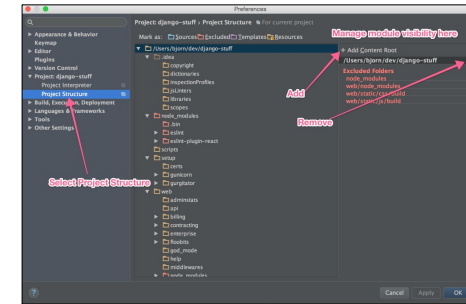


Set the classpath of java projects in Eclipse

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With Python

- *Python module path* resolves references to modules
 - Environnement variable PYTHONPATH



Set the pythonpath of python projects in PyCharm

<https://docs.python.org/3/using/cmdline.html#envvar-PYTHONPATH>

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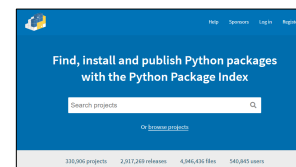
Library repository

- Place where libraries and their metadata are stored
 - example for Linux:
 - <https://wiki.debian.org/DebianRepository/>
 - <https://help.ubuntu.com/community/Repositories/Ubuntu>

https://en.wikipedia.org/wiki/Software_repository

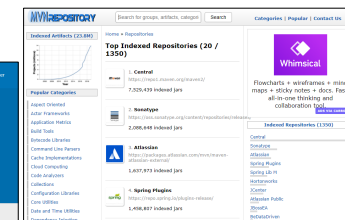
Library repository

- Place where libraries and their metadata are stored
 - Java: Maven Central
 - .NET: NuGet
 - Node.js: npm
 - Python: PyPI
 - ...

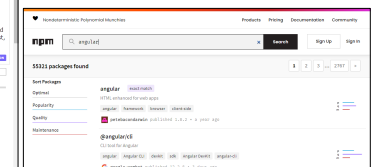


PyPI central repository
<https://pypi.org/>

https://en.wikipedia.org/wiki/Software_repository



Maven distributed repositories
<https://maven.apache.org/> - <https://search.maven.org/> - ...



npm central repository
<https://npmjs.com/>

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Library manager

- Software that allows to download or update libraries and their dependencies (transitive)

Package Manager	Description
npm	A package manager for Node.js ^[21]
pip	A package installer for Python ^[22]
apt	For managing Debian Packages ^[23]
Homebrew	A package installer for MacOS that allows you to install packages Apple didn't ^[24]
vcpkg	A package manager for C and C++ ^{[25][26]}
yum and dnf	Package manager for Fedora and Red Hat Enterprise Linux ^[27]
pacman	Package manager for Arch Linux ^[28]

https://en.wikipedia.org/wiki/Software_repository

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Typical library artifacts

- Binaries, sources, documentation
- Metadata
 - Name, description
 - Publisher, developer
 - version number
 - Links to sources, issue tracker
 - Checksum
 - Necessary dependencies
- Example for Java: com.google.code.gson:gson:2.8.8
<https://mvnrepository.com/artifact/com.google.code.gson/gson/2.8.8> --> link « view all »
- Example for Ubuntu: asciidoc:8.6.10-2
<https://packages.ubuntu.com/source/bionic/asciidoc> --> download dsc

https://en.wikipedia.org/wiki/Software_repository

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Java maven central: G-A-V coordinates

- **G-A-V = Group, Artefact, Version**

```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 http://maven.apache.org/maven-v4_0_0.xsd">
  <modelVersion>4.0.0</modelVersion>
  <parent>
    <groupId>com.google.code.gson</groupId>
    <artifactId>gson-parent</artifactId>
    <version>2.8.8</version>
  </parent>
  <artifactId>gson</artifactId>
  <name>Gson</name>
  <dependencies>
    <dependency>
      <groupId>junit</groupId>
      <artifactId>junit</artifactId>
      <scope>test</scope>
    </dependency>
    <dependency>
      <groupId>com.github.wvengen</groupId>
      <artifactId>proguard-maven-plugin</artifactId>
      <version>2.4.0</version>
      <scope>test</scope>
    </dependency>
  </dependencies>
</project>
```

<https://repo1.maven.org/maven2/com/google/code/gson/gson/2.8.8/gson-2.8.8.pom>



com/google/code/gson/gson	
1.0.0	2008-04-10 14:29
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Software versions

- Version name unique to a software state
 - internal names (build number or timestamp)
 - names for publication
- A wide variety of naming choices
 - When should you change this or that part of the version name?

https://en.wikipedia.org/wiki/Software_versioning

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Software versions

- Version name unique to a software state
 - internal names (build number or timestamp)
 - names for publication
- A wide variety of naming choices
 - When should you change this or that part of the version name?
 - Marketing and superstition sometimes get in the way
 - Photoshop 5 -> 5.5
 - Office 2007 (v12) -> Office 2010 (v14)
 - Sometimes specified by language
 - Python: PEP 440 – Version Identification and Dependency Specification

https://en.wikipedia.org/wiki/Software_versioning

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<https://www.commitstrip.com/en/2013/08/20/numeros-de-version/>

The convention is sometimes singular
TeX 3 ; 3.1 ; 3.14 ; 3.141 ; 3.1415 ; ...

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Software versions

- Calendar Versioning (CalVer)
 - Office 2007, 2010
 - Ubuntu 18.04 = April 2018
 - Wine 20040505 = 2004-05-05
- Standardisation attempt: <https://calver.org/>

2020.1.4018-pre

year release build status

<https://calver.org/>

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Software versions

- Semantic Versioning (SemVer)

- Standardisation attempt: <https://semver.org>

- **MAJOR**: increment = change not retro-compatible
- **Minor**: increment = feature added
- **Patch**: increment = bug corrected

- x.y.z-a1 = first alpha version
- x.y.z-b3 = third beta version
- x.y.z-rc1 = first release candidate
- 0.y.z = work in progress

4.2.1
MAJOR Minor patch

<https://semver.org>

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<https://www.commitstrip.com/en/2019/01/24/1-10-or-1-1/>

CommitStrip.com

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... Your turn

Technological foundations of software development

Master your development environment and software dependencies

Complete the TODO section:

https://ci.mines-stetienne.fr/cps2/course/tfsd/course-2.html#_todos