



University of
Zurich^{UZH}

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UNIVERSITÄT
BERN

```
/**  
 * A class representing a window on the screen.  
 *  
 * For example:  
 *   Window win = new Window(parent);  
 *   win.show();  
 */  
class Window {  
    ...  
}
```



Decoding computer science from female lenses

Dr. Pooja Rani

Post-doc, University of Zurich,
Switzerland

Jhattipur, Haryana, India



Academic Journey



2008 - 2011: **Diploma in Computer Engineering,**
Haryana, India.

2011 - 2014: **Bachelors in Computer Science & Engineering,**
Kolkata, India.

2015 - 2017: **Masters in Software System,**
Rajasthan, India.

2018 - 2022: **Ph.D in Software Engineering**
at University of Bern, Switzerland.

Industrial Journey

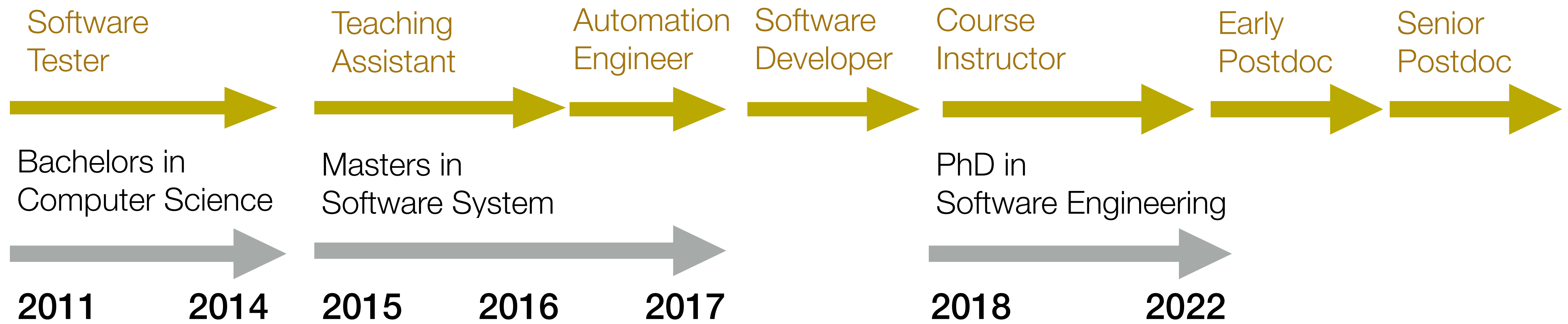
Jul 2011 - Jul 2014: **Software Tester**
at *Samsung Research Institute, Noida, India.*

Jan 2017 - May 2017: **Automation Engineer**
at *VMware, Bangalore, India.*

Jun 2017 - Nov 2017: **Software Developer**
at *People Interactive Group, Mumbai, India.*



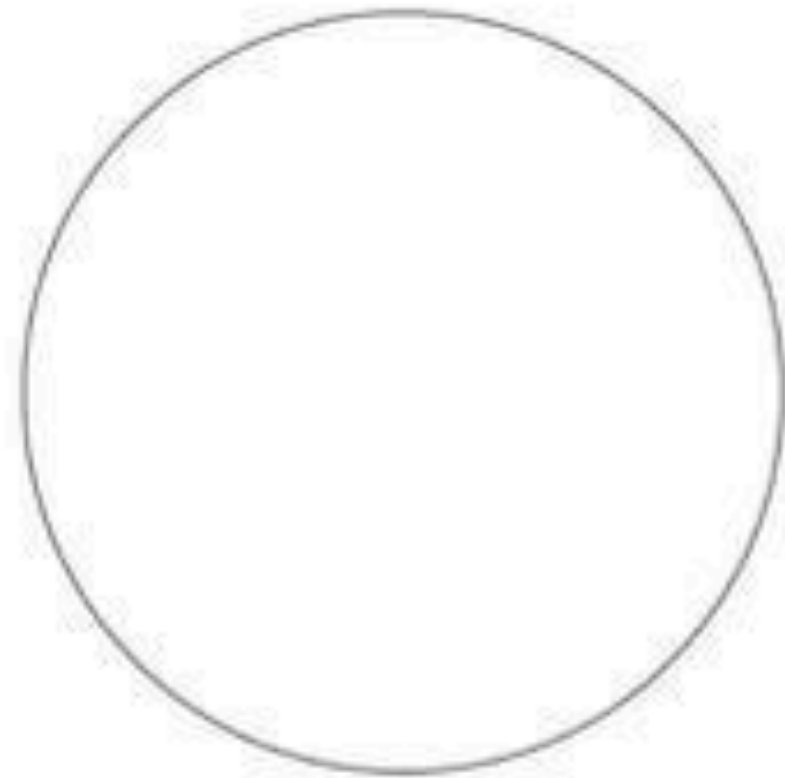
Journey



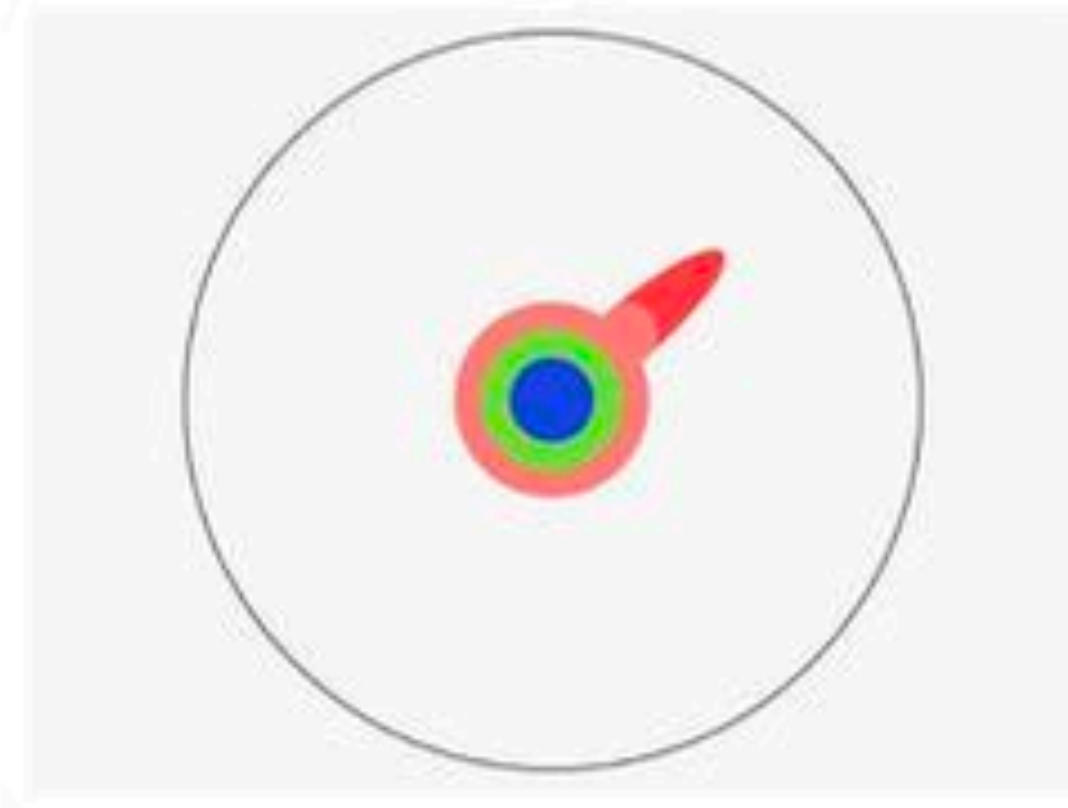
Why research?

Why research?

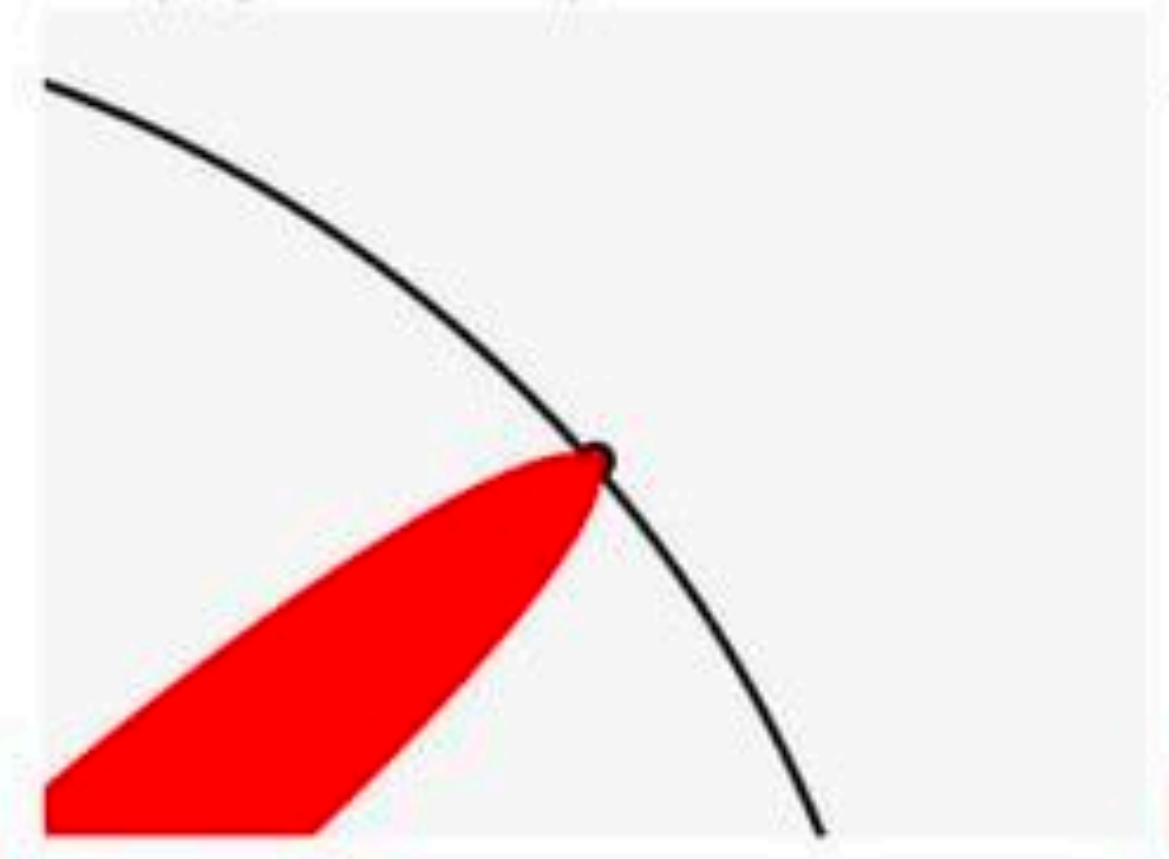
Imagine a circle that contains all of human knowledge:



A master's degree deepens that specialty:



Until one day, the boundary gives way:



Why **computer science** research?

Because it is fun



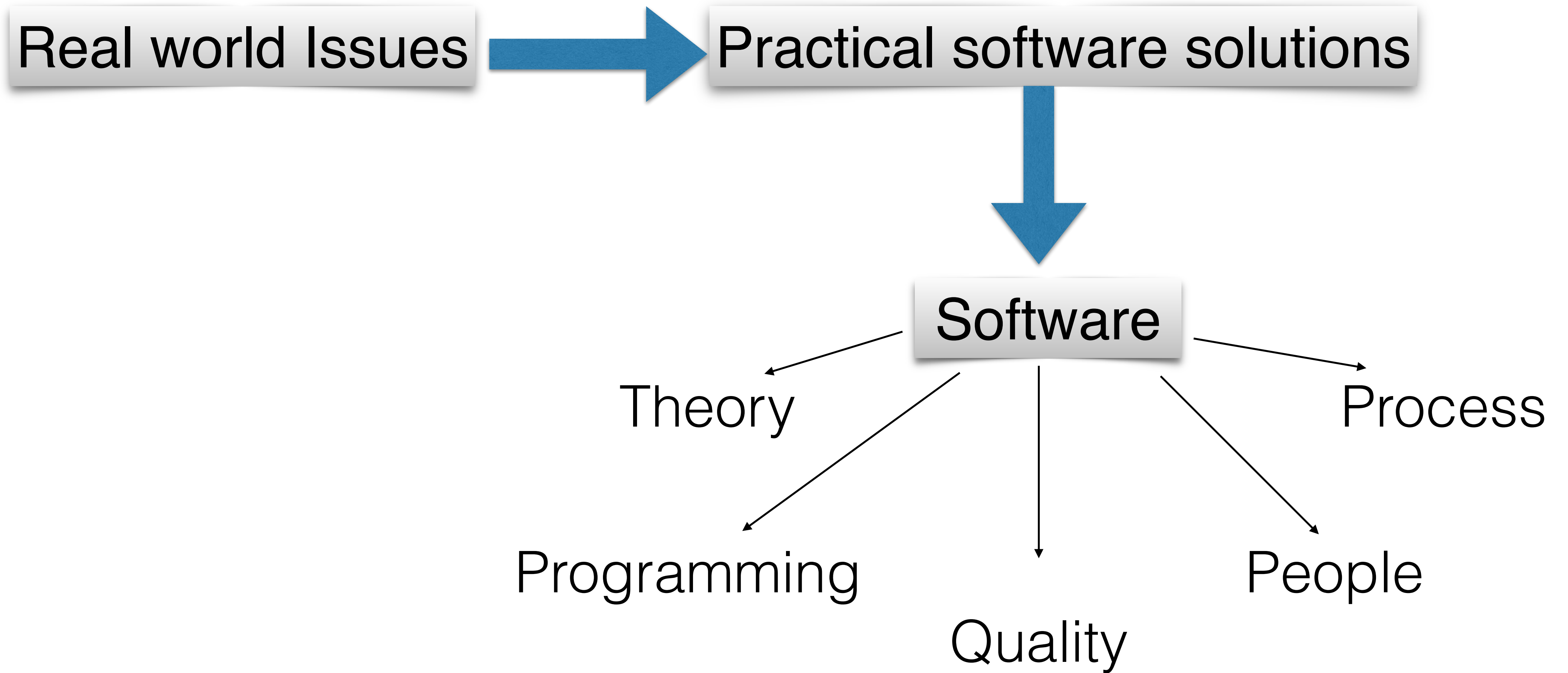
Because it **helps**

Real world Issues

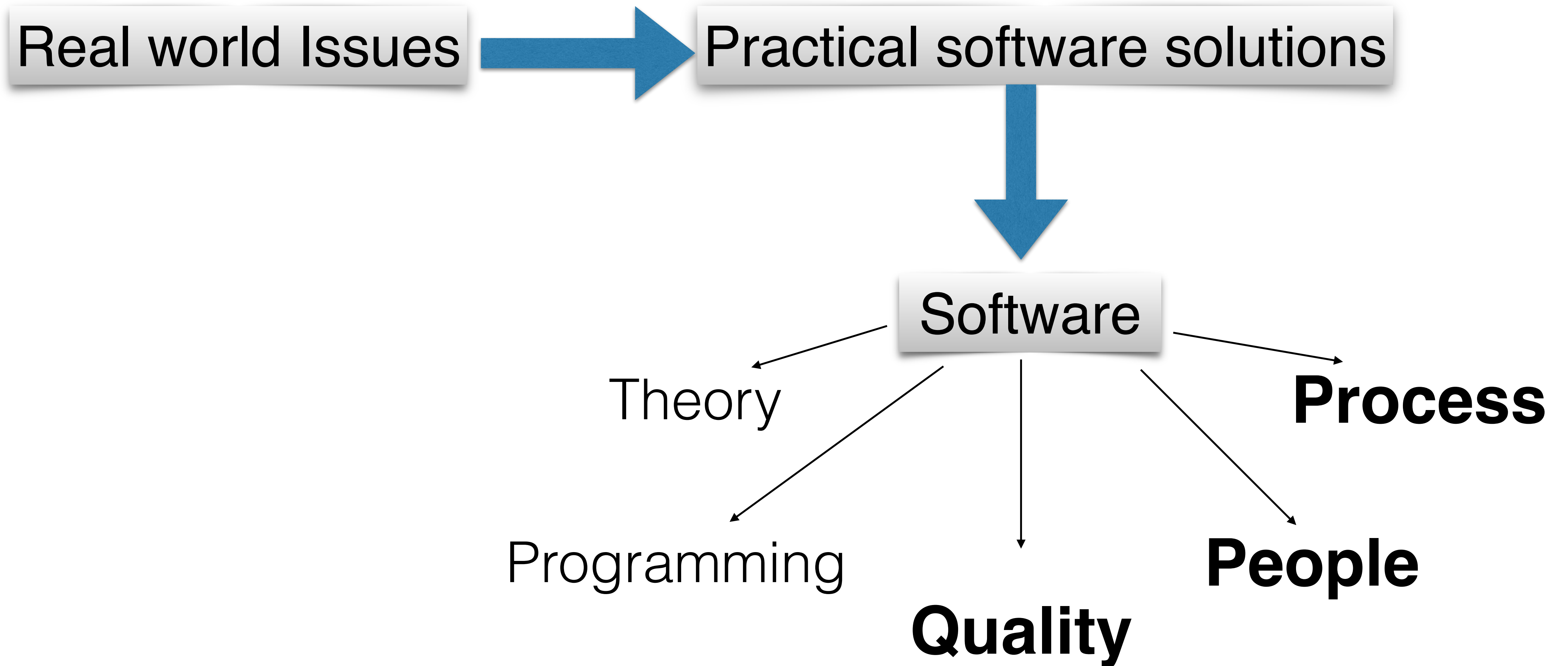


Practical software solutions

Because it **helps**



Because it **helps**



Because it helps

Real world Issues



Practical software solutions



Software

```
1 package spicetify;
2
3 import javafx.scene.Parent;
4 import javafx.scene.Scene;
5 import javafx.scene.image.Image;
6 import javafx.scene.image.ImageView;
7 import javafx.scene.layout.BorderPane;
8 import javafx.scene.paint.Color;
9 import javafx.stage.Stage;
10
11 public class HomeWindow extends BaseWindow{
12     private ImageView logoView;
13     private Parent root;
14     private Scene scene;
15     BaseWindow baseWindow = new BaseWindow();
16     Sidebar sidebar = new Sidebar(baseWindow.getHeight(), 100, "#282828", root);
17
18     public HomeWindow(){
19         this.root = new BorderPane();
20         this.logoView = new ImageView(new Image("file:src/main/resources/spicetify/images/essentials/logo.png"));
21         this.scene = baseWindow.getScene();
22     }
23
24     public HomeWindow(int width, int height, String html){
25         this.logoView = new ImageView(new Image("file:src/main/resources/spicetify/images/essentials/logo.png"));
26         this.root = new BorderPane();
27         this.scene = baseWindow.getScene();
28         baseWindow.setWidth(width);
29         baseWindow.setMinWidth(width);
30         baseWindow.setHeight(height);
31         baseWindow.setMinHeight(height);
```

Complex multi-language software

apache / spark Public

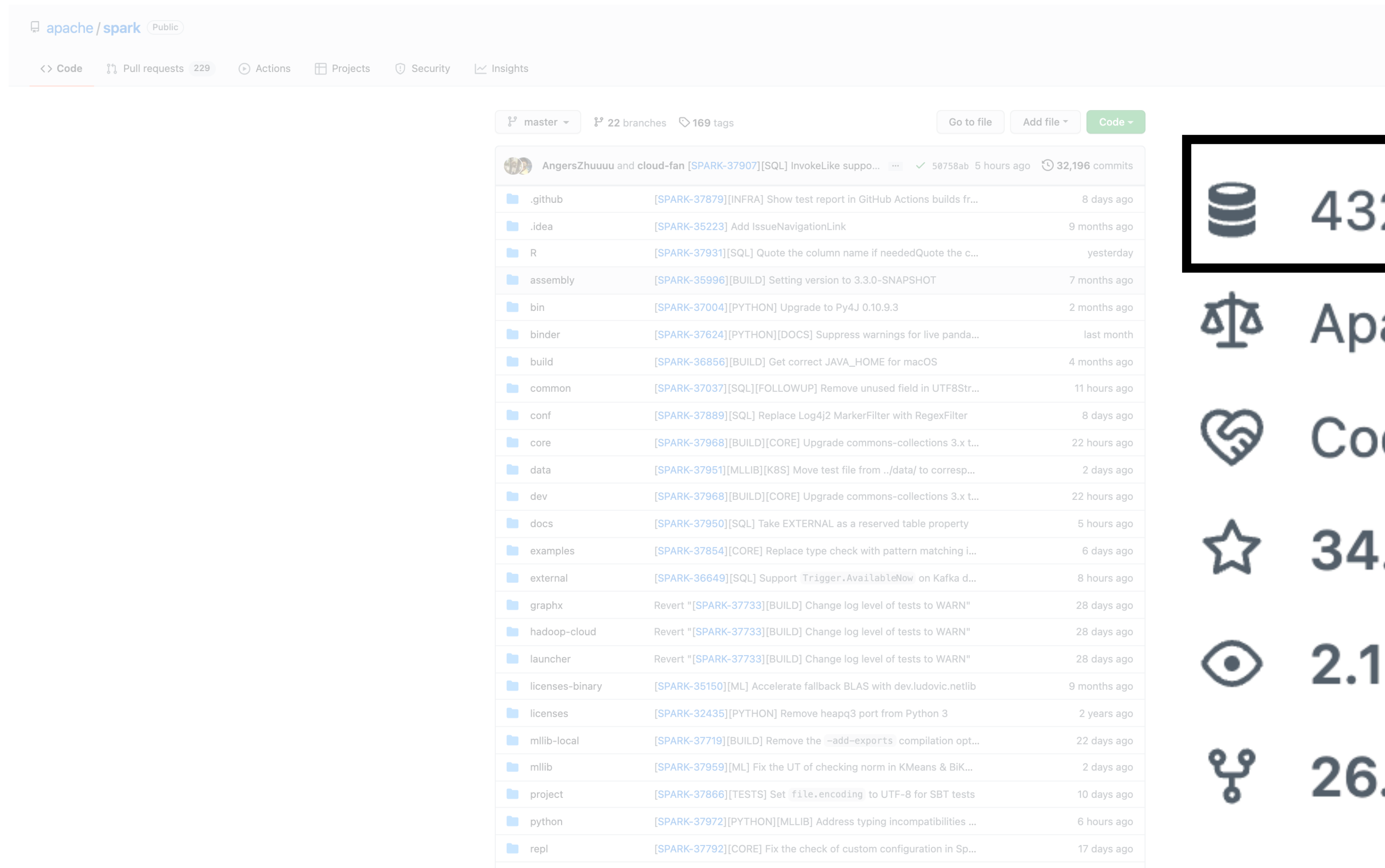
[Code](#) [Pull requests](#) 229 [Actions](#) [Projects](#) [Security](#) [Insights](#)

master 22 branches 169 tags [Go to file](#) [Add file](#) [Code](#)

AngersZhuuuu and cloud-fan [SPARK-37907][SQL] InvokeLike suppo... 50758ab 5 hours ago 32,196 commits

.github	[SPARK-37879][INFRA] Show test report in GitHub Actions builds fr...	8 days ago
.idea	[SPARK-35223] Add IssueNavigationLink	9 months ago
R	[SPARK-37931][SQL] Quote the column name if neededQuote the c...	yesterday
assembly	[SPARK-35996][BUILD] Setting version to 3.3.0-SNAPSHOT	7 months ago
bin	[SPARK-37004][PYTHON] Upgrade to Py4J 0.10.9.3	2 months ago
binder	[SPARK-37624][PYTHON][DOCS] Suppress warnings for live panda...	last month
build	[SPARK-36856][BUILD] Get correct JAVA_HOME for macOS	4 months ago
common	[SPARK-37037][SQL][FOLLOWUP] Remove unused field in UTF8Str...	11 hours ago
conf	[SPARK-37889][SQL] Replace Log4j2 MarkerFilter with RegexFilter	8 days ago
core	[SPARK-37968][BUILD][CORE] Upgrade commons-collections 3.x t...	22 hours ago
data	[SPARK-37951][MLLIB][K8S] Move test file from ../data/ to corresp...	2 days ago
dev	[SPARK-37968][BUILD][CORE] Upgrade commons-collections 3.x t...	22 hours ago
docs	[SPARK-37950][SQL] Take EXTERNAL as a reserved table property	5 hours ago
examples	[SPARK-37854][CORE] Replace type check with pattern matching i...	6 days ago
external	[SPARK-36649][SQL] Support Trigger.AvailableNow on Kafka d...	8 hours ago
graphx	Revert "[SPARK-37733][BUILD] Change log level of tests to WARN"	28 days ago
hadoop-cloud	Revert "[SPARK-37733][BUILD] Change log level of tests to WARN"	28 days ago

Complex **multi-language** software



 **432.28 MB**

 **Apache-2.0, Apache-2.0**

 **Code of conduct**

 **34.2k stars**

 **2.1k watching**

 **26.2k forks**

Compare it to Apollo 11 mission: to the moon with 4 KB of RAM

Complex **multi-language** software



 **432.28 MB**

 Apache-2.0, Apache-2.0

 Code of conduct

 **34.2k stars**

 **2.1k watching**

 **26.2k forks**

Compare it to Apollo 11 mission: to the moon with 4 KB of RAM

Complex **multi-language** software

The screenshot displays the Apache Spark GitHub repository page. At the top, navigation links include Code, Pull requests (229), Actions, Projects, Security, and Insights. The repository is currently on the master branch, with 22 branches and 169 tags. A commit history table lists recent changes, such as adding test reports in GitHub Actions builds and updating issue navigation links. The repository structure includes folders like .github, .idea, R, assembly, bin, binder, build, common, conf, core, data, dev, docs, examples, external, graphx, hadoop-cloud, launcher, licenses-binary, licenses, mllib-local, mllib, project, python, and repl. On the right, the 'About' section describes Apache Spark as a unified analytics engine for large-scale data processing, with links to the website (spark.apache.org) and various languages (python, java, r, scala, sql, big-data, spark, jdbc). It also lists project details like 395.77 MB size, Apache-2.0 License, 31.9k stars, 2.1k watching, and 25.1k forks. A 'Contributors' section highlights 1,771 contributors, with a '+ 1,760 contributors' badge. Below this, a 'Languages' section shows a bar chart of supported languages: Scala (66.1%), Python (12.2%), Java (7.5%), Jupyter Notebook (7.1%), HiveQL (3.1%), R (2.1%), and Other (1.9%).

Commit	Author	Message	Time
[SPARK-37879][INFRA]	AngersZhuuuu and cloud-fan	Show test report in GitHub Actions builds fr...	8 days ago
[SPARK-35223]		Add IssueNavigationLink	9 months ago
[SPARK-37931][SQL]		Quote the column name if neededQuote the c...	yesterday
[SPARK-35996][BUILD]		Setting version to 3.3.0-SNAPSHOT	7 months ago
[SPARK-37004][PYTHON]		Upgrade to Py4J 0.10.9.3	2 months ago
[SPARK-37624][PYTHON][DOCS]		Suppress warnings for live panda...	last month
[SPARK-36856][BUILD]		Get correct JAVA_HOME for macOS	4 months ago
[SPARK-37037][SQL][FOLLOWUP]		Remove unused field in UTF8Str...	11 hours ago
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[SPARK-36649][SQL]		Support Trigger.AvailableNow on Kafka d...	8 hours ago
[SPARK-37733][BUILD]		Change log level of tests to WARN"	28 days ago
[SPARK-37733][BUILD]		Change log level of tests to WARN"	28 days ago
[SPARK-37733][BUILD]		Change log level of tests to WARN"	28 days ago
[SPARK-35150][ML]		Accelerate fallback BLAS with dev.ludovic.netlib	9 months ago
[SPARK-32435][PYTHON]		Remove heapq3 port from Python 3	2 years ago
[SPARK-37719][BUILD]		Remove the --add-exports compilation opt...	22 days ago
[SPARK-37959][ML]		Fix the UT of checking norm in KMeans & BIK...	2 days ago
[SPARK-37866][TESTS]		Set file.encoding to UTF-8 for SBT tests	10 days ago
[SPARK-37972][PYTHON][MLLIB]		Address typing incompatibilities ...	6 hours ago
[SPARK-37792][CORE]		Fix the check of custom configuration in Sp...	17 days ago

Language	Percentage
Scala	66.1%
Python	12.2%
Java	7.5%
Jupyter Notebook	7.1%
HiveQL	3.1%
R	2.1%
Other	1.9%

Complex multi-language software

The screenshot shows the Apache Spark GitHub repository page. At the top, it displays the repository name 'apache/spark' and navigation links for Code, Pull requests (229), Actions, Projects, Security, and Insights. Below this, there are buttons for 'Go to file', 'Add file', and 'Code'. The main content area shows a list of commits, each with a folder icon, a commit message, and a timestamp. The commits are sorted by time, with the most recent at the top. The right sidebar contains information about the repository, including the description 'Apache Spark - A unified analytics engine for large-scale data processing', the website 'spark.apache.org', and various statistics like 31.9k stars and 25.1k forks. At the bottom right, there is a 'Languages' section with a horizontal bar chart and a list of languages and their percentages.

Folder	Commit Message	Time Ago
.github	[SPARK-37879][INFRA] Show test report in GitHub Actions builds fr...	8 days ago
.idea	[SPARK-35223] Add IssueNavigationLink	9 months ago
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launcher	Revert "[SPARK-37733][BUILD] Change log level of tests to WARN"	28 days ago
licenses-binary	[SPARK-35150][ML] Accelerate fallback BLAS with dev.ludovic.netlib	9 months ago
licenses	[SPARK-32435][PYTHON] Remove heapq3 port from Python 3	2 years ago
mlib-local	[SPARK-37719][BUILD] Remove the --add-exports compilation opt...	22 days ago
mlib	[SPARK-37959][ML] Fix the UT of checking norm in KMeans & BIK...	2 days ago
project	[SPARK-37866][TESTS] Set file.encoding to UTF-8 for SBT tests	10 days ago
python	[SPARK-37972][PYTHON][MLLIB] Address typing incompatibilities ...	6 hours ago
repl	[SPARK-37792][CORE] Fix the check of custom configuration in Sp...	17 days ago

Languages

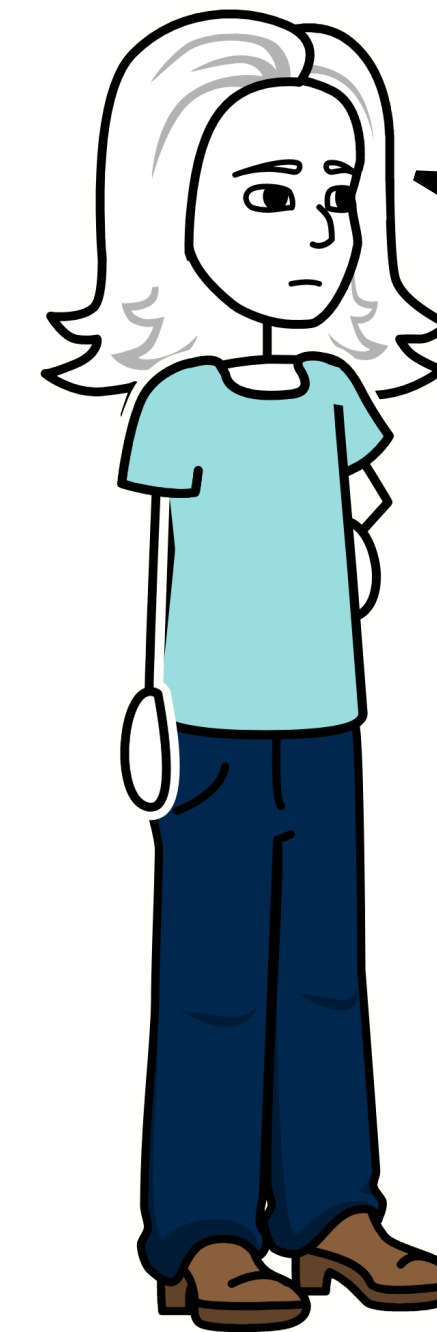
- Scala 66.1%
- Python 12.2%
- Java 7.5%
- Jupyter Notebook 7.1%
- HiveQL 3.1%
- R 2.1%
- Other 1.9%

Source code

```
1 package spicetify;
2
3 import javafx.scene.Parent;
4 import javafx.scene.Scene;
5 import javafx.scene.image.Image;
6 import javafx.scene.image.ImageView;
7 import javafx.scene.layout.BorderPane;
8 import javafx.scene.paint.Color;
9 import javafx.stage.Stage;
10
11 public class HomeWindow extends BaseWindow{
12     private ImageView logoView;
13     private Parent root;
14     private Scene scene;
15     BaseWindow baseWindow = new BaseWindow();
16     Sidebar sidebar = new Sidebar(baseWindow.getHeight(), 100, "#282828", root);
17
18     public HomeWindow(){
19         this.root = new BorderPane();
20         this.logoView = new ImageView(new Image("file:src/main/resources/spicetify/images/essentials/logo.png"));
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22     }
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31         baseWindow.setMinHeight(height);
32         baseWindow.setHtmlColor(html);
33     }
34
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36     public void start(Stage stage){
37         root.setStyle("-fx-background-color: transparent;");
38         ((BorderPane) root).setLeft(sidebar.getSidebar());
39         baseWindow.transform(logoView, 600, 700, true);
40         ((BorderPane) root).setCenter(logoView);
```

How to ensure its quality?

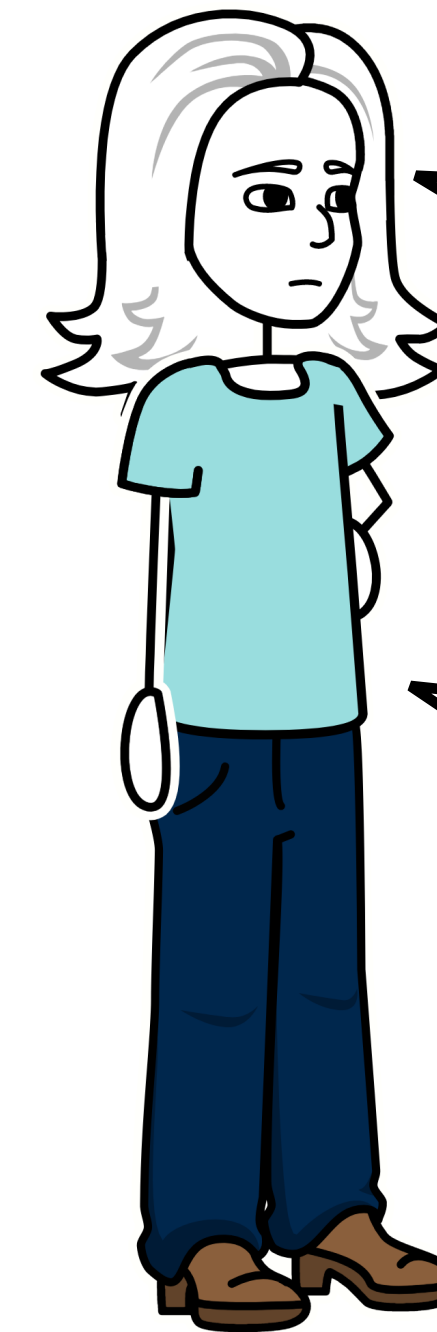
```
1 package spicetify;
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3 import javafx.scene.Parent;
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5 import javafx.scene.image.Image;
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36     public void start(Stage stage){
37         root.setStyle("-fx-background-color: transparent;");
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40         ((BorderPane) root).setCenter(logoView);
```



Is
this a high-quality
code?

How to ensure its quality?

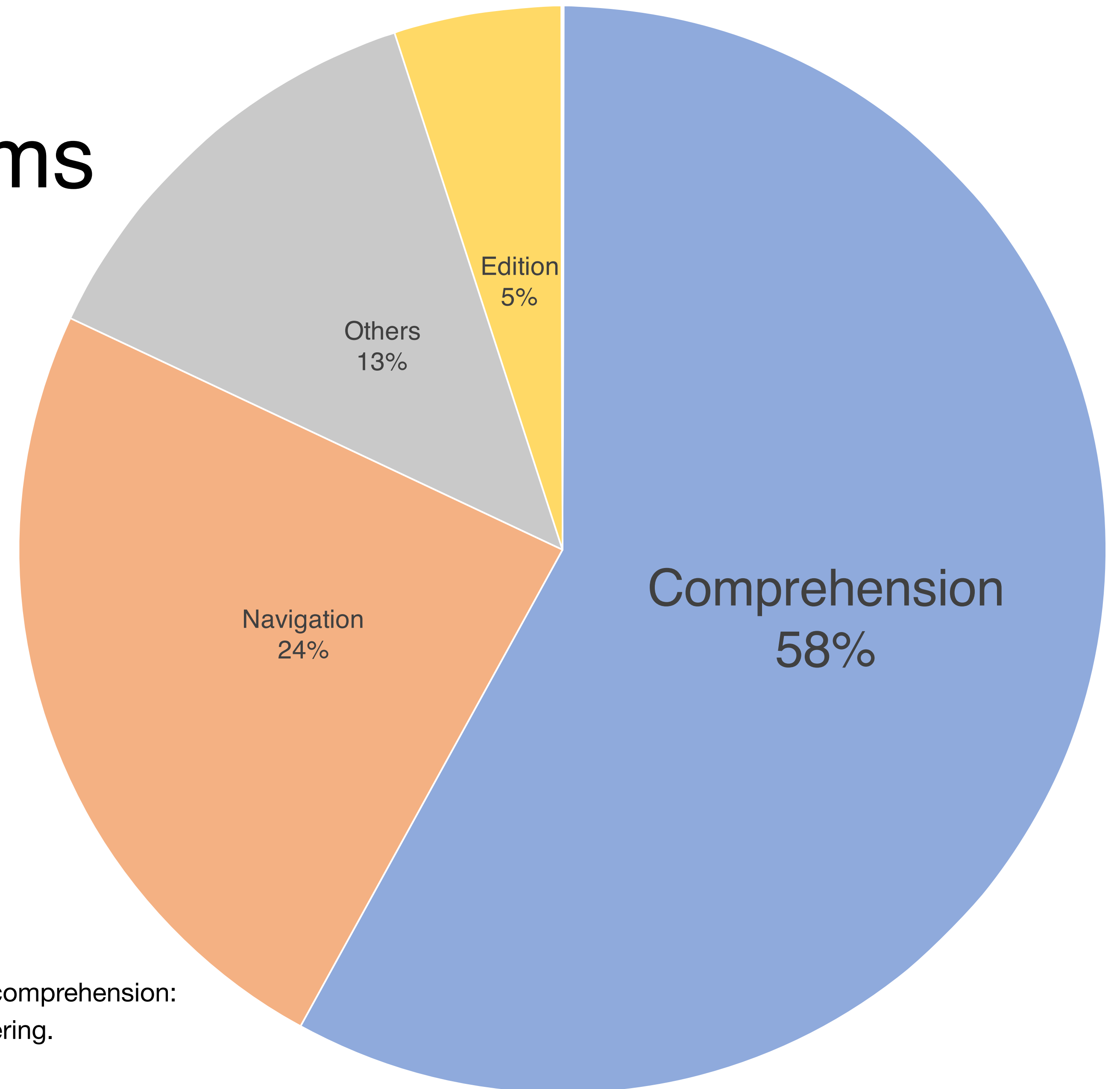
```
1 package spicetify;
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4 import javafx.scene.Scene;
5 import javafx.scene.image.Image;
6 import javafx.scene.image.ImageView;
7 import javafx.scene.layout.BorderPane;
8 import javafx.scene.paint.Color;
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```



Is
this a high-quality
code?

Is this
understandable?

Software developers spend majority of their in understanding programs



Xia, X., Bao, L., Lo, D., Xing, Z., Hassan, A. E., & Li, S. (2017). Measuring program comprehension: A large-scale field study with professionals. IEEE Transactions on Software Engineering.

Check code documentation

```
1 package spicetify;
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3 import javafx.scene.Parent;
4 import javafx.scene.Scene;
5 import javafx.scene.image.Image;
6 import javafx.scene.image.ImageView;
7 import javafx.scene.layout.BorderPane;
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11 public class HomeWindow extends BaseWindow{
12     private ImageView logoView;
13     private Parent root;
14     private Scene scene;
15     BaseWindow baseWindow = new BaseWindow();
16     Sidebar sidebar = new Sidebar(baseWindow.getHeight(), 100, "#282828", /**;
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18     public HomeWindow(){
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40         ((BorderPane) root).setCenter(logoView);
```

```
/**;
 * A class representing a window on the screen.
 *
 * For example:
 * <pre>
 *     HomeWindow win = new HomeWindow(parent);
 *     win.show();
 * </pre>
 *
 * @author Sami Shaio
 * @version 1.13, 06/08/06
 * @see java.awt.BaseWindow
 * @see java.awt.Button
 */
class HomeWindow extends BaseWindow {
    ...
}
```

Peer code review

```
1 package spicetify;
2
3 import javafx.scene.Parent;
4 import javafx.scene.Scene;
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6 import javafx.scene.image.ImageView;
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9 import javafx.stage.Stage;
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11 public class HomeWindow extends BaseWindow{
12     private ImageView logoView;
13     private Parent root;
14     private Scene scene;
15     BaseWindow baseWindow = new BaseWindow();
16     Sidebar sidebar = new Sidebar(baseWindow.getHeight(), 100, "add-source.svg");
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18     public HomeWindow(){
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```

The screenshot shows a code review interface. On the left is a file explorer with a search bar 'Filter changed files'. The tree structure is as follows:

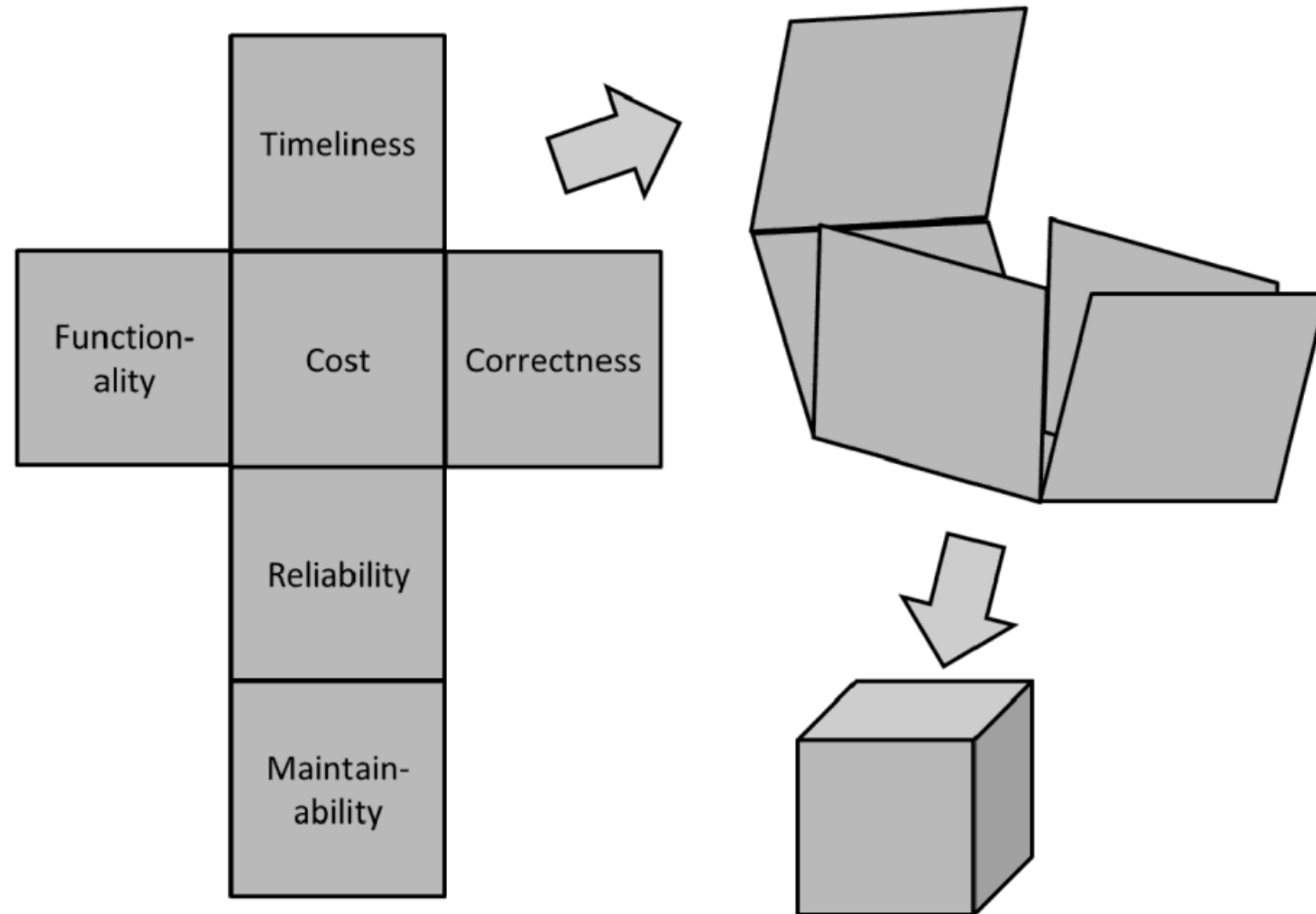
- frontend
 - assets/images/icons
 - add-source.svg
 - src/Editor
 - Editor.jsx
 - LeftSidebar
 - SidebarDatasources.jsx
 - index.js
 - QueryManager
 - DataSourceLister.jsx
 - QueryManager.jsx

On the right, two diff views are shown. The top view is for 'frontend/src/Editor/Editor.jsx' with 8 changes. The bottom view is for 'frontend/src/Editor/LeftSidebar/SidebarDatasources.jsx' with 3 changes.

Line	Start	End	Change
1255	1261		is_maintenance_on={this.state.app.is_maint
1256	1263		isSaving={this.state.isSaving}
1257	1264		isUnsavedQueriesAvailable={this.state.isU
1258	1265		/>
1480	1487		allComponents={appDefinition
1481	1488		isSourceSelected={this.state
1482	1489		isQueryPaneDragging={this.st
1483	1491		setStateOfUnsavedQueries={th
1484	1492		/>
1485	1493		</div>

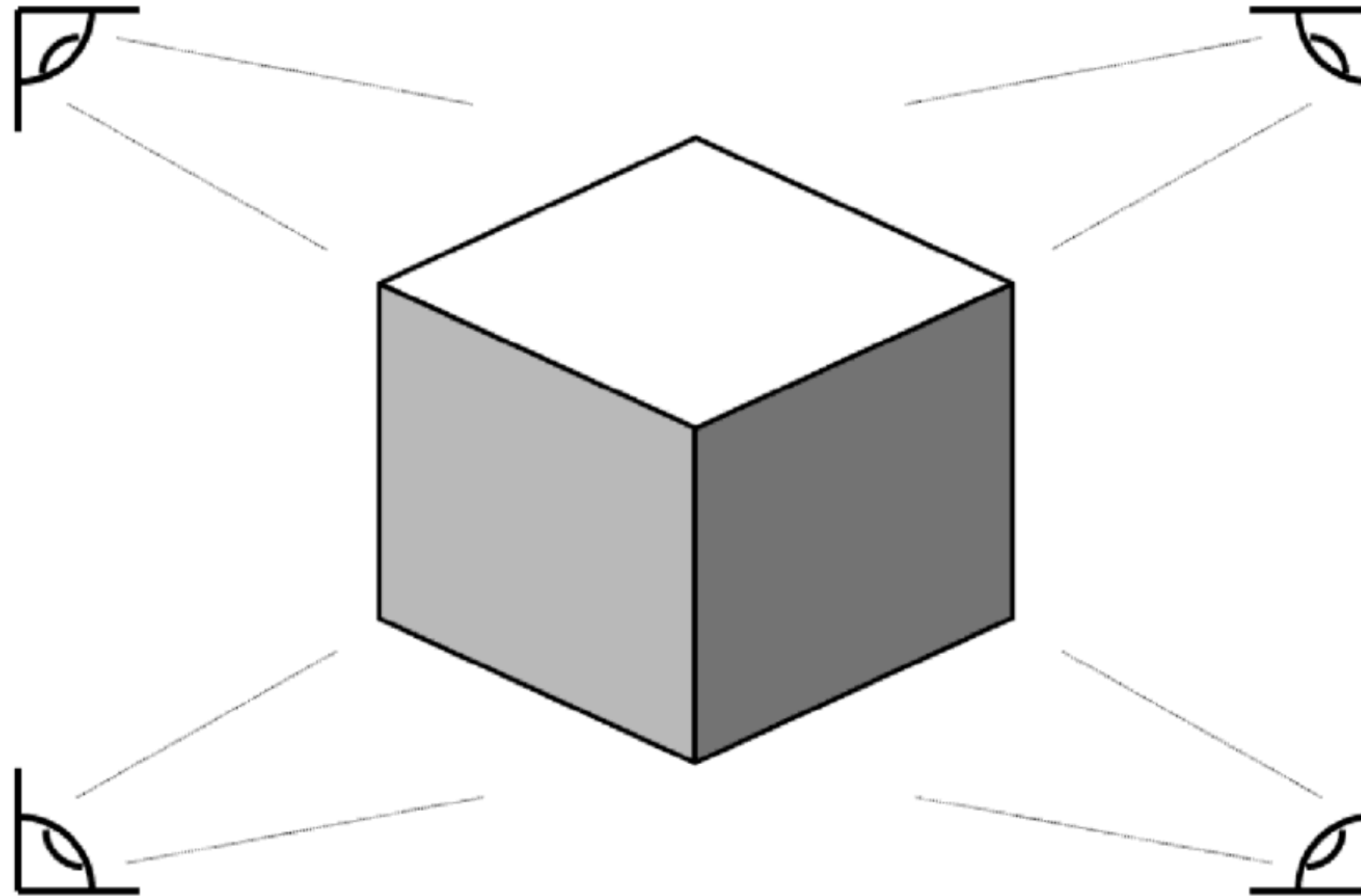
Line	Start	End	Change
18	18		dataSources = [],
19	19		dataSourcesChanged,
20	20		dataQueriesChanged,
21		21	+ toggleDataSourceManagerModal,
22		22	+ showDataSourceManagerModal,
21	23		}) => {
22	24		const [open, trigger, content] = usePopover(false);
23		23	- const [showDataSourceManagerModal, toggleDataSourceMa
24	25		const [selectedDataSource, setSelectedDataSource]

Quality is a multi-dimensional concept



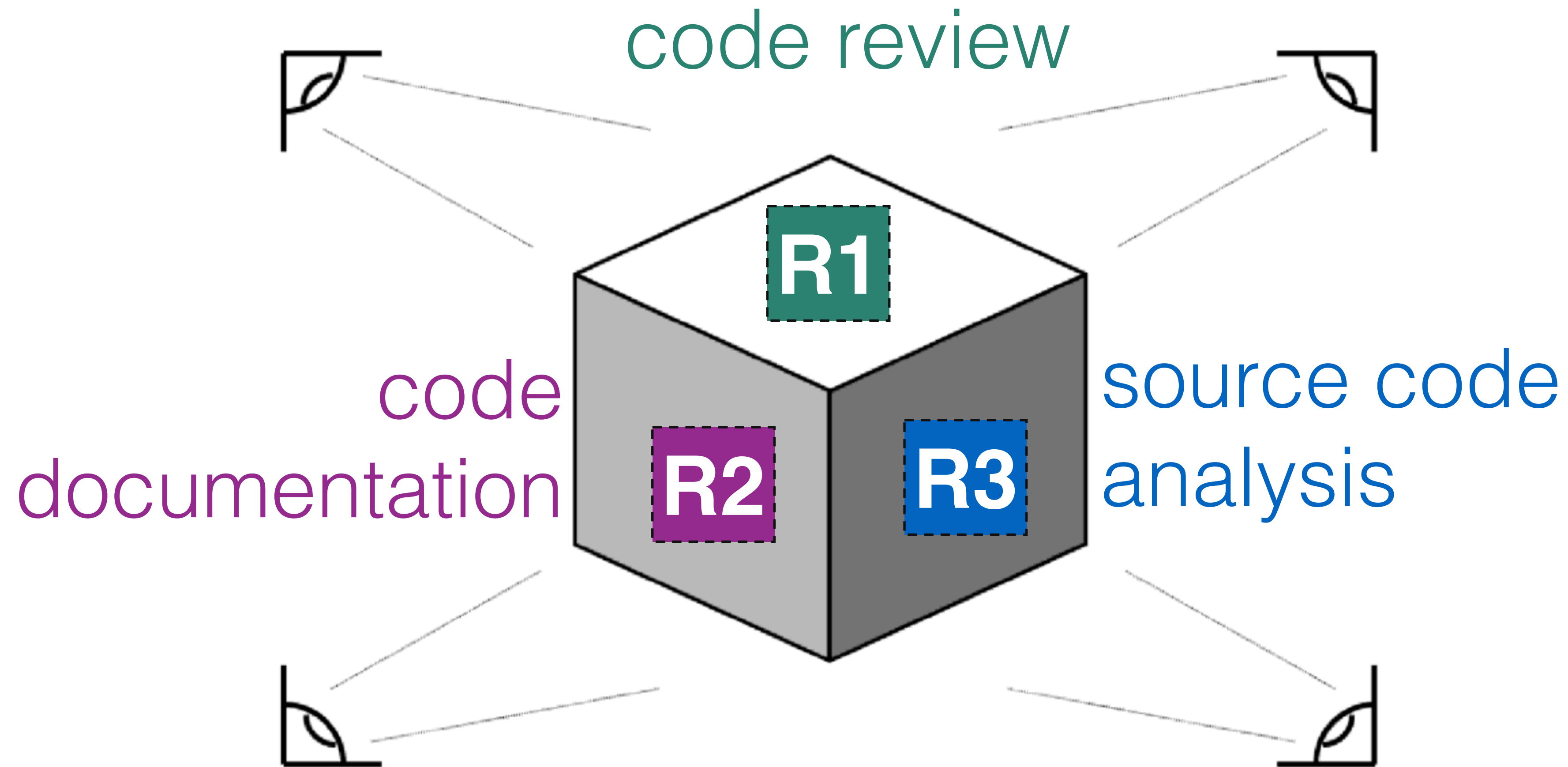
Gillies et al. 2011

It requires a multi-perspective view



Gillies et al. 2011

It requires a multi-perspective view



Whether the tools are **sufficient** and the development process is **sustainable** or not?

How about others in **computer science** research?

73% of the field comprised of Men

Women are highly underrepresented especially in higher roles

How did we reach here?

Stereotype

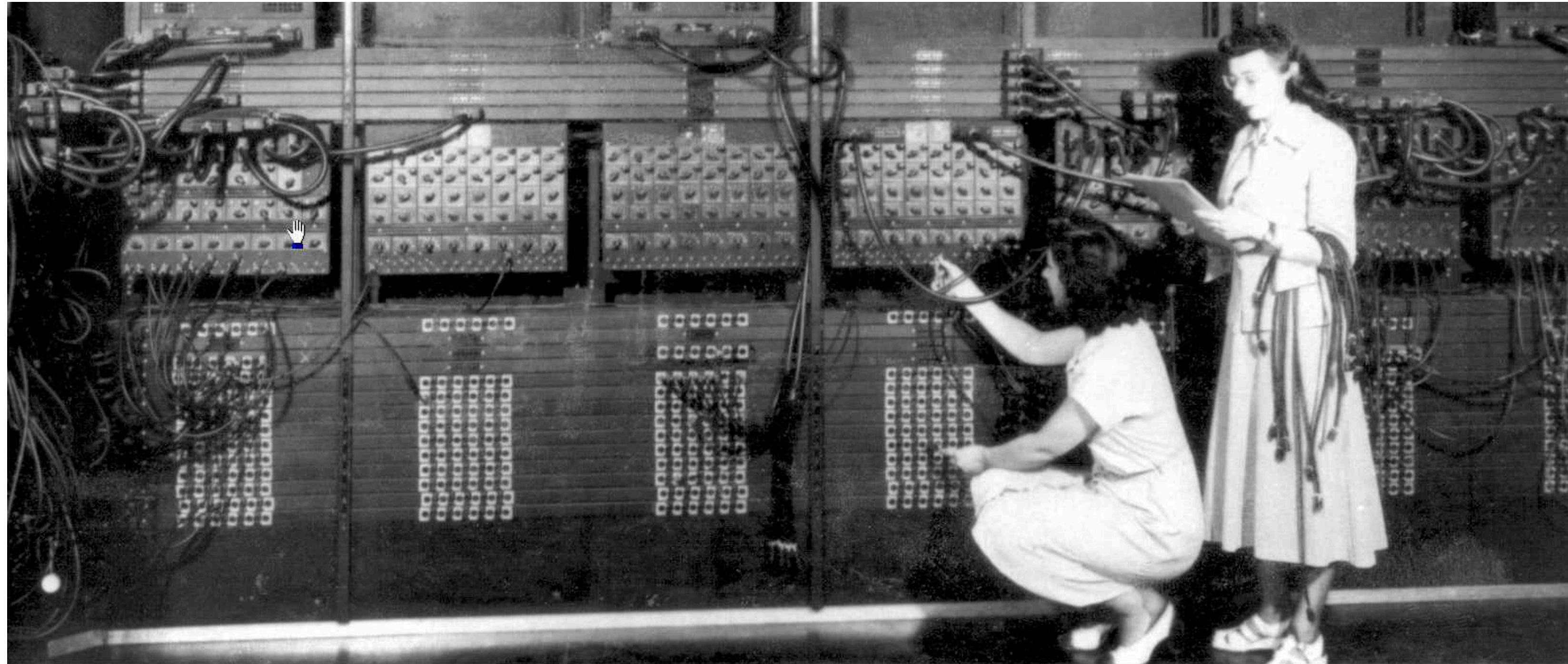
Awareness

How did we reach here?

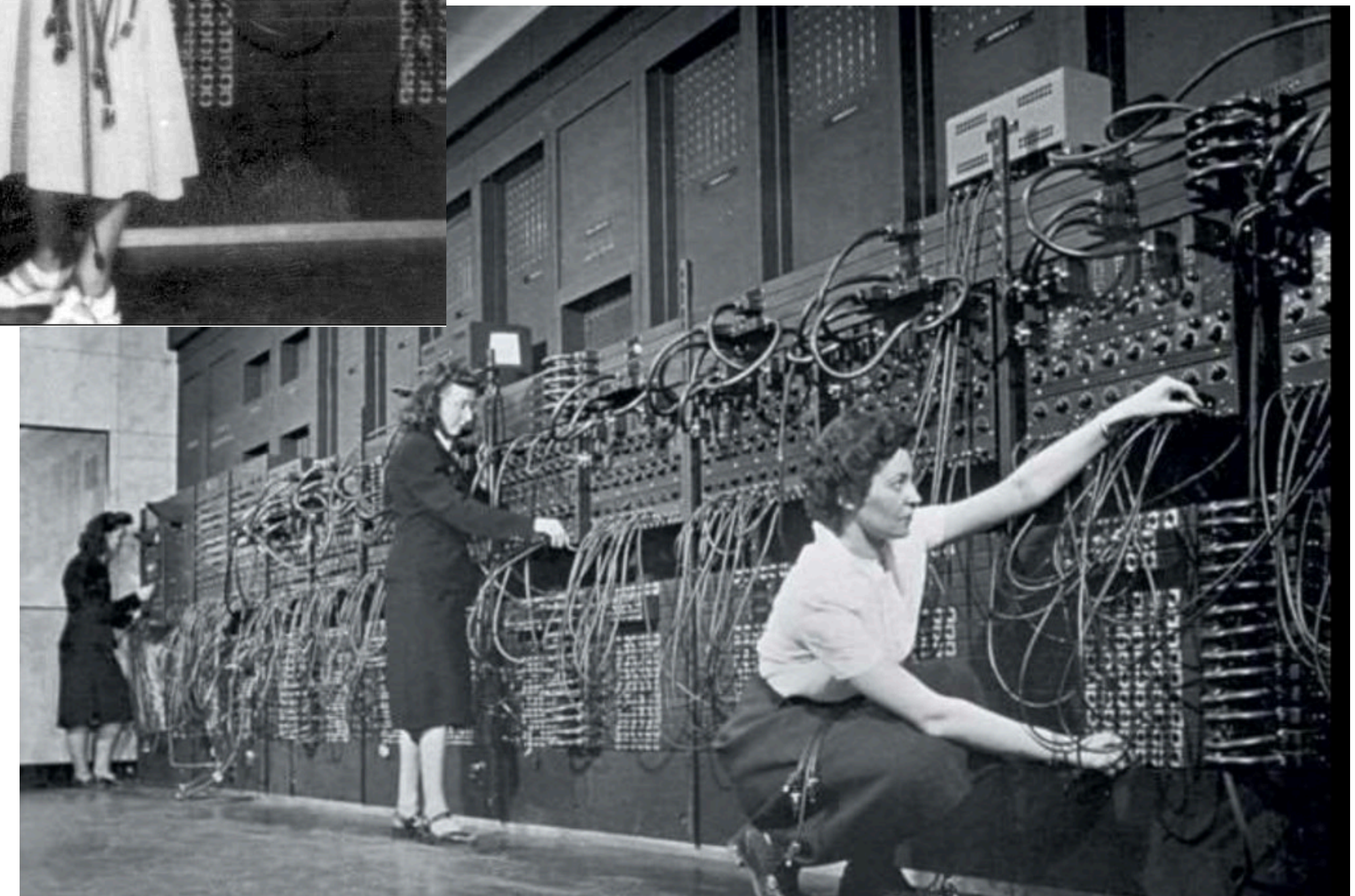
Culture

Personality

We had stereotypes



When Computer Coding was a 'Woman's' Job



We had career awareness



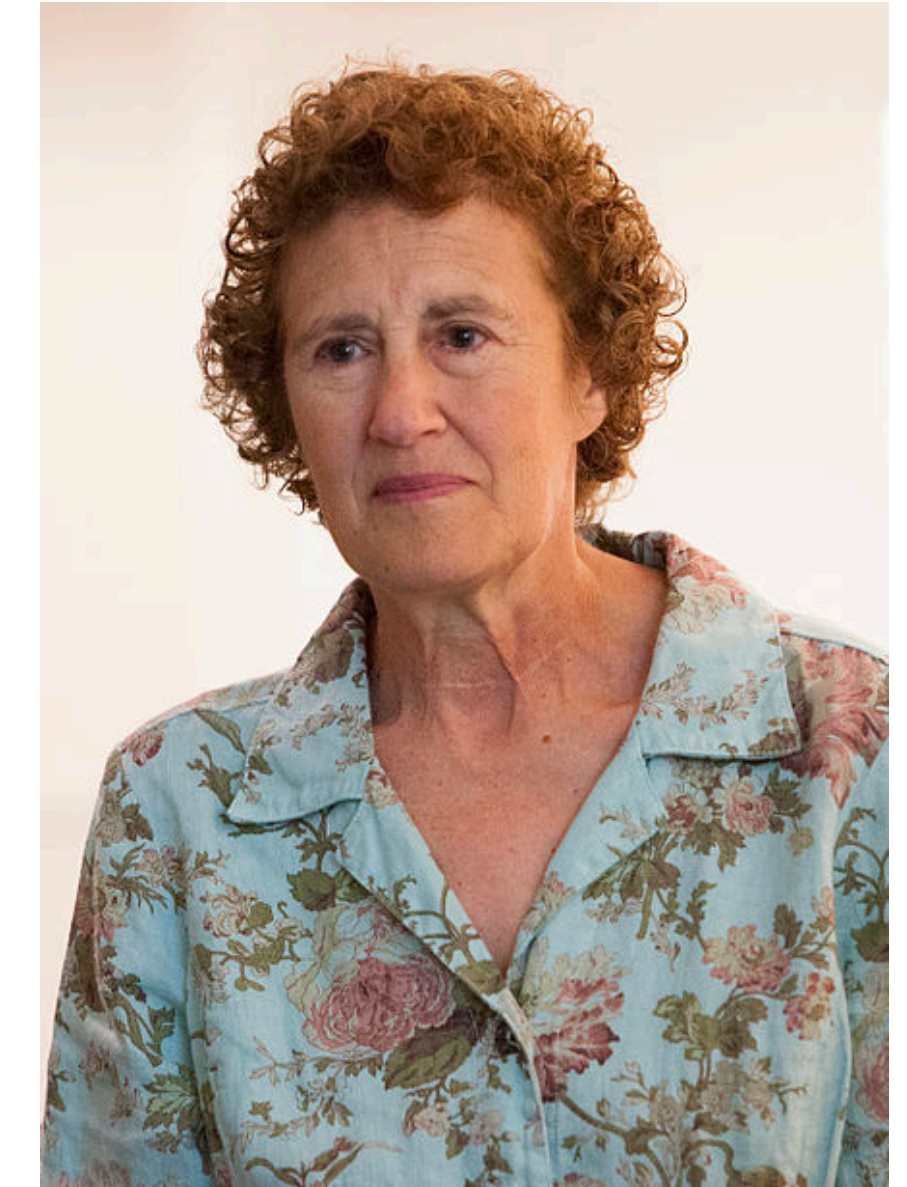
Ada Lovelace
The first programmer



Margaret Hamilton's
Apollo code



Grace Hopper
First compiler for computer programming language



Barbara Liskov
Liskov substitution principal

Early role models

We had culture & personality



The Computer Girls

BY LOIS MANDEL

A trainee gets \$8,000 a year
... a girl "senior systems analyst"
gets \$20,000—and up!
Maybe it's time to investigate....

Ann Richardson, IBM systems engineer, designs a bridge via computer. Above (left) she checks her facts with fellow systems engineer, Marvin V. Fuchs. Right, she feeds facts into the computer. Below, Ann demonstrates on a viewing screen how her facts designed the bridge, and makes changes with a "light pen."

Twenty years ago, a girl could be a secretary, a school teacher . . . maybe a librarian, a social worker or a nurse. If she was really ambitious, she could go into the professions and compete with men . . . usually working harder and longer to earn less pay for the same job.

Now have come the big, dazzling computers—and a whole new kind of work for women: programming. Telling the miracle machines what to do and how to do it. Anything from predicting the weather to sending out billing notices from the local department store.

And if it doesn't sound like woman's work—well, it just is.

("I had this idea I'd be standing at a big machine and pressing buttons all day long," says a girl who programs for a Los Angeles bank. I couldn't have been further off the track. I figure out how the

computer can solve a problem, and then instruct the machine to do it."

"It's just like planning a dinner," explains Dr. Grace Hopper, now a staff scientist in systems programming for Univac. (She helped develop the first electronic digital computer, the Eniac, in 1946.) "You have to plan ahead and schedule everything so it's ready when you need it. Programming requires patience and the ability to handle detail. Women are 'naturals' at computer programming."

What she's talking about is *aptitude*—the one most important quality a girl needs to become a programmer. She also needs a keen, logical mind. And if that zeroes out the old Billie Burke-Gracie Allen image of femininity, it's about time, because this is the age of the Computer Girls. There are twenty thousand of them in the United (cont. on page 54)



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Photos by Henry Grossman. Dress by Gino Charles.

Women are 'naturals' at computer programming



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Stereotype;

computer as a boy's toy, geeky boys...

Awareness;

limited knowledge about STEM careers...

How did we reach here?

Culture;

culture specific, unequal opportunities, more responsibilities...

Personality;

anti-socialness, impersonal ...

Culture specific

- ◆ Women earned only 18% of bachelor's degree in computer science in the U.S
- ◆ Women constitute 42% of undergraduate students in computer science in India

Stereotype;

Break them...

Awareness;

Find mentors, learn required skills

What can we do?

Culture;

Utilise opportunities, Find balance...

Personality;

personal; educate community

Why computer science?

- ◆ To bring perspective (look at games developed by males)
- ◆ Less pay gap
- ◆ Software development requires interpersonal skills
- ◆ Flexible work schedule
- ◆ It is fun

Programs

- ◆ Girls who code
- ◆ GirlStart
- ◆ Technovation
- ◆ University programs

“This is not a field women are newcomers to, This is a field where they have a history and belong” - Janet Abbate