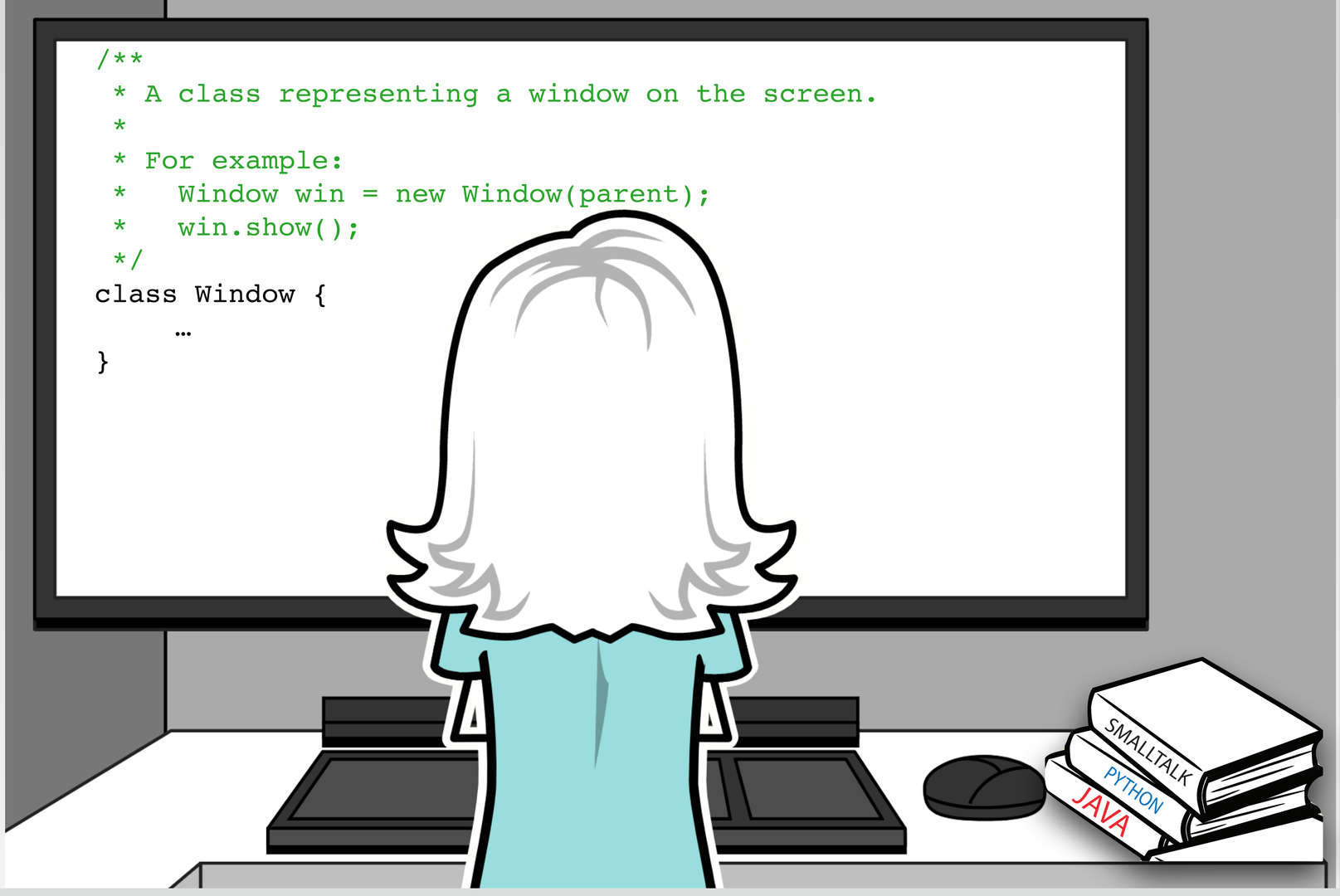


Decoding computer science from female lenses

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*.

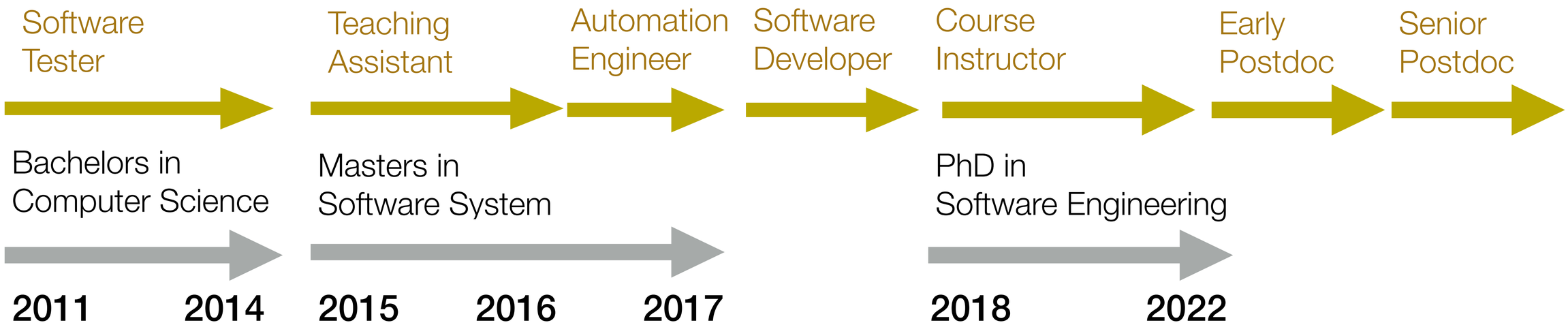
Industrial Journey

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.

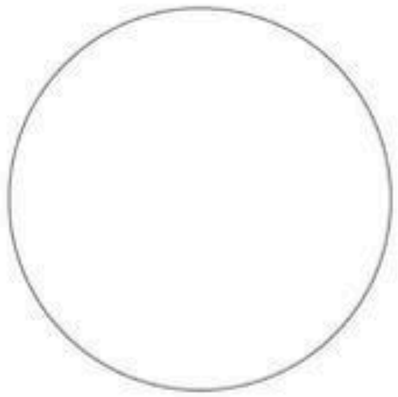
Journey


Software Tester
Teaching Assistant
Automation Engineer
Software Developer
Course Instructor
Early Postdoc
Senior Postdoc
Bachelors in Computer Science
Masters in Software System
PhD in Software Engineering
2011
2014
2015
2016
2017
2018
2022

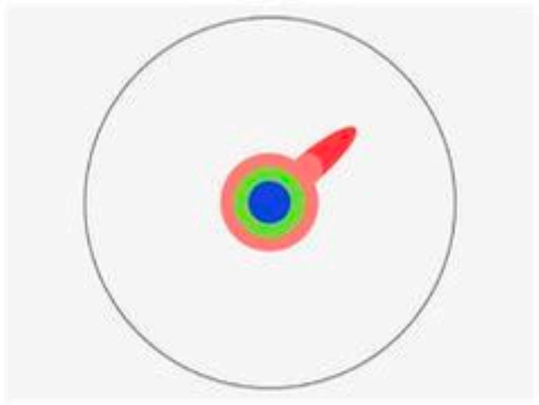
Why research?

Why research?

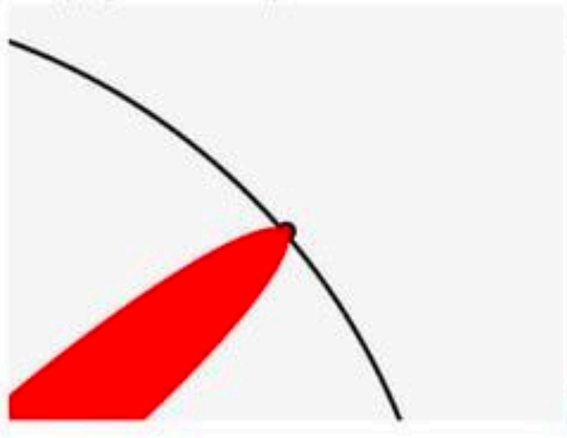
Imagine a circle that contains all of human knowledge:



A master's degree deepens that specialty:



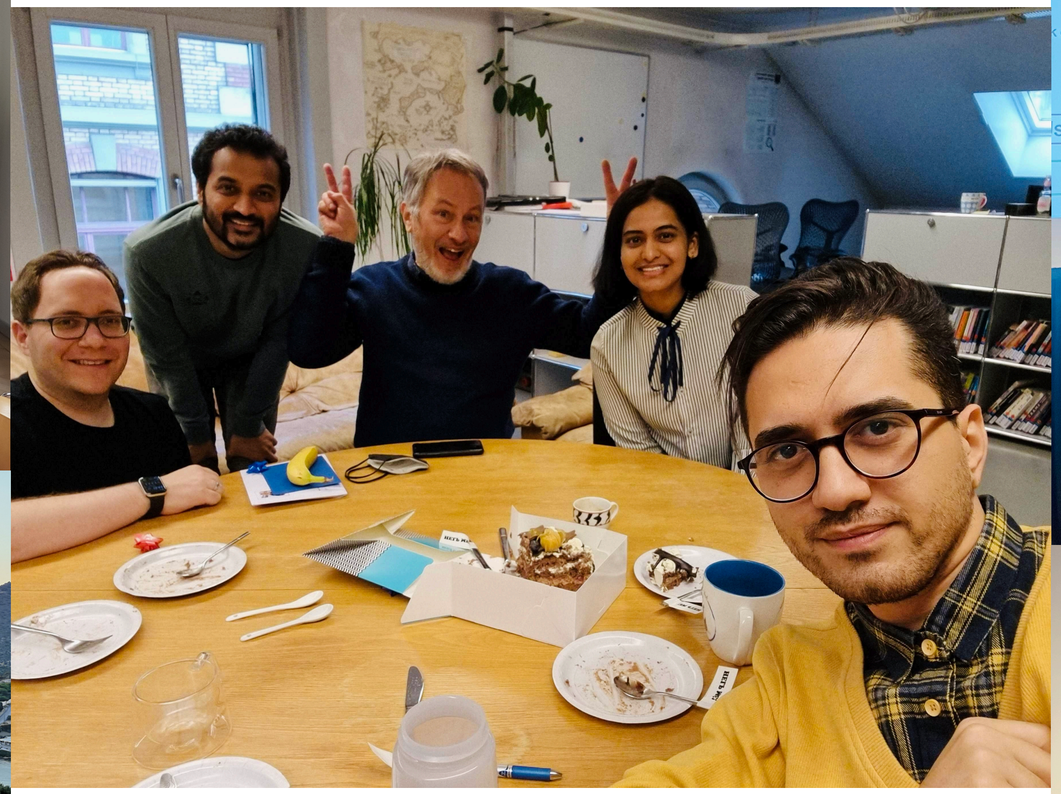
Until one day, the boundary gives way:



—-Matt Might

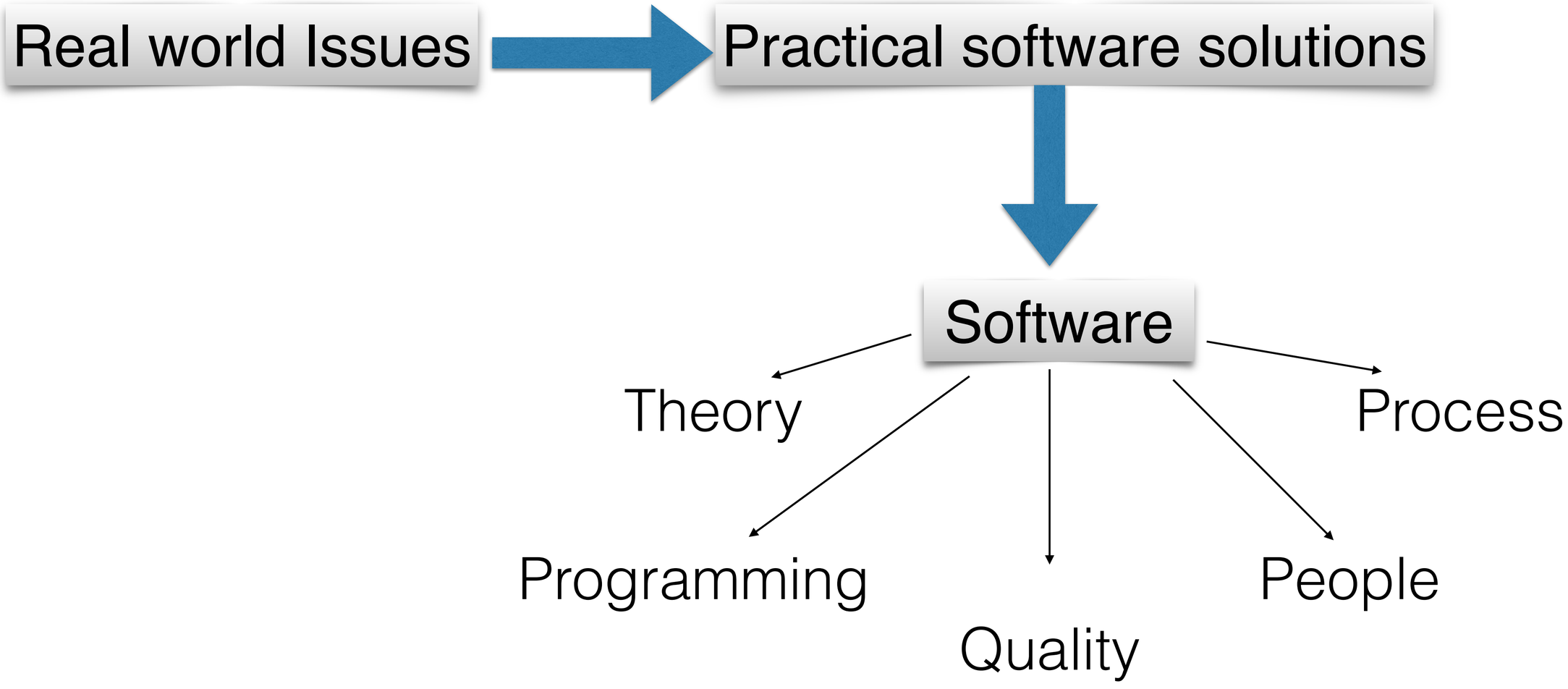
Why **computer science** research?

Because it is **fun**

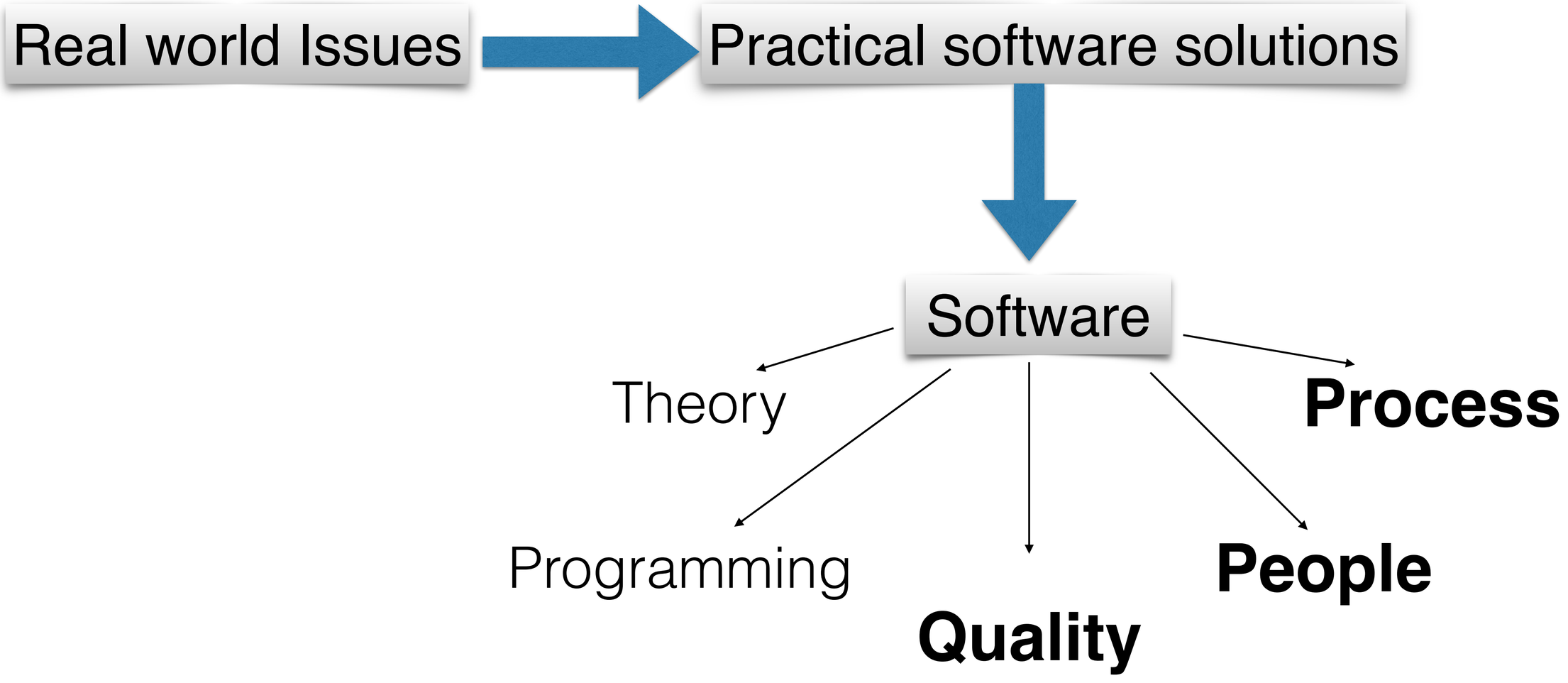


Because it **helps**

Because it **helps**



Because it **helps**



Because it **helps**

Real world Issues → Practical software solutions

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

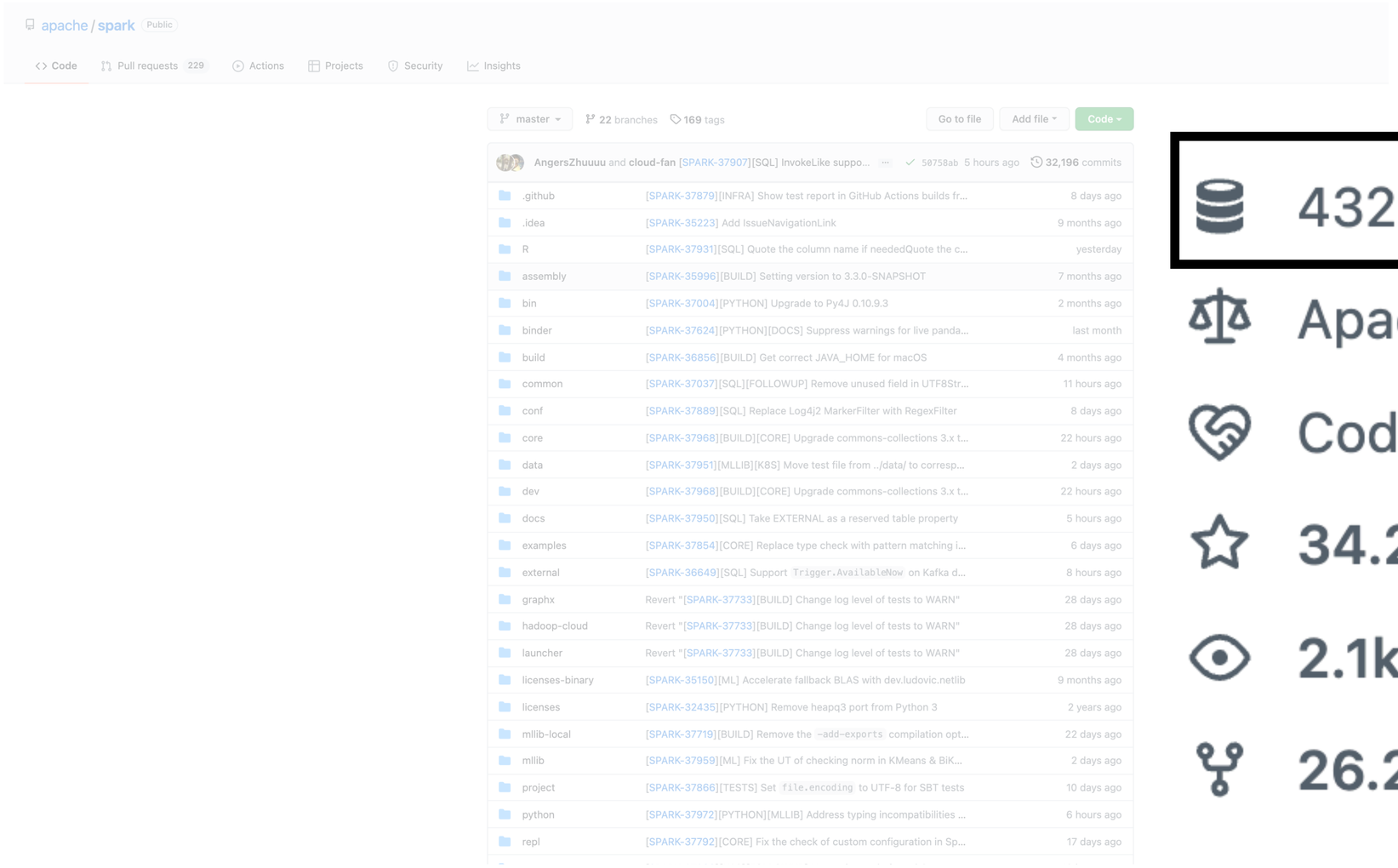
Code | Pull requests 229 | Actions | Projects | Security | Insights

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

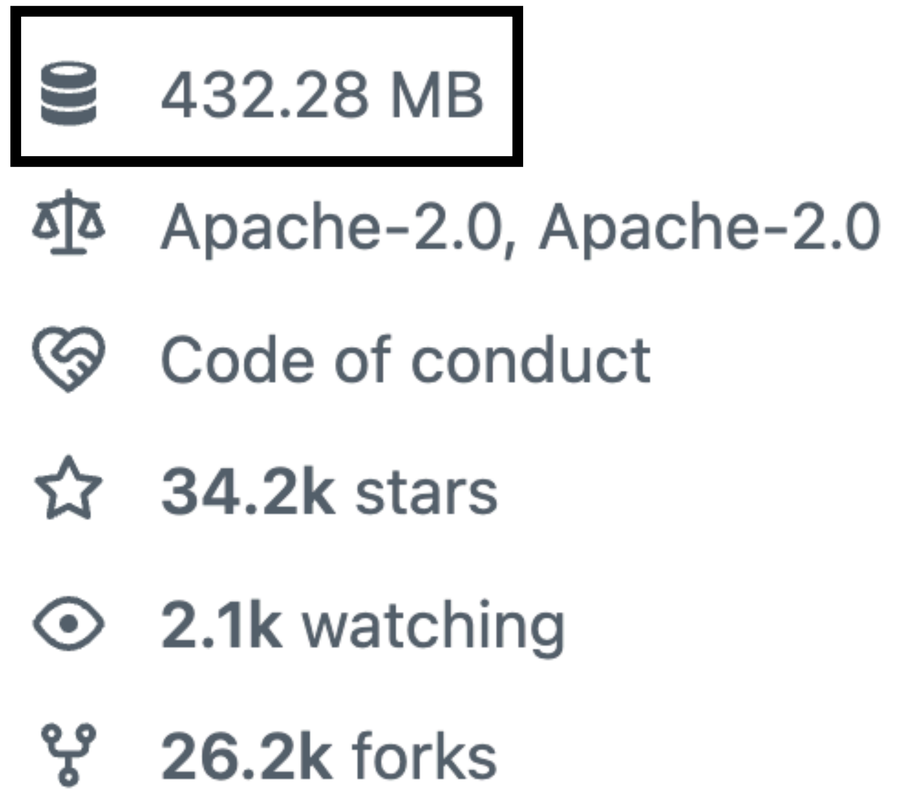
Complex **multi-language** software



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

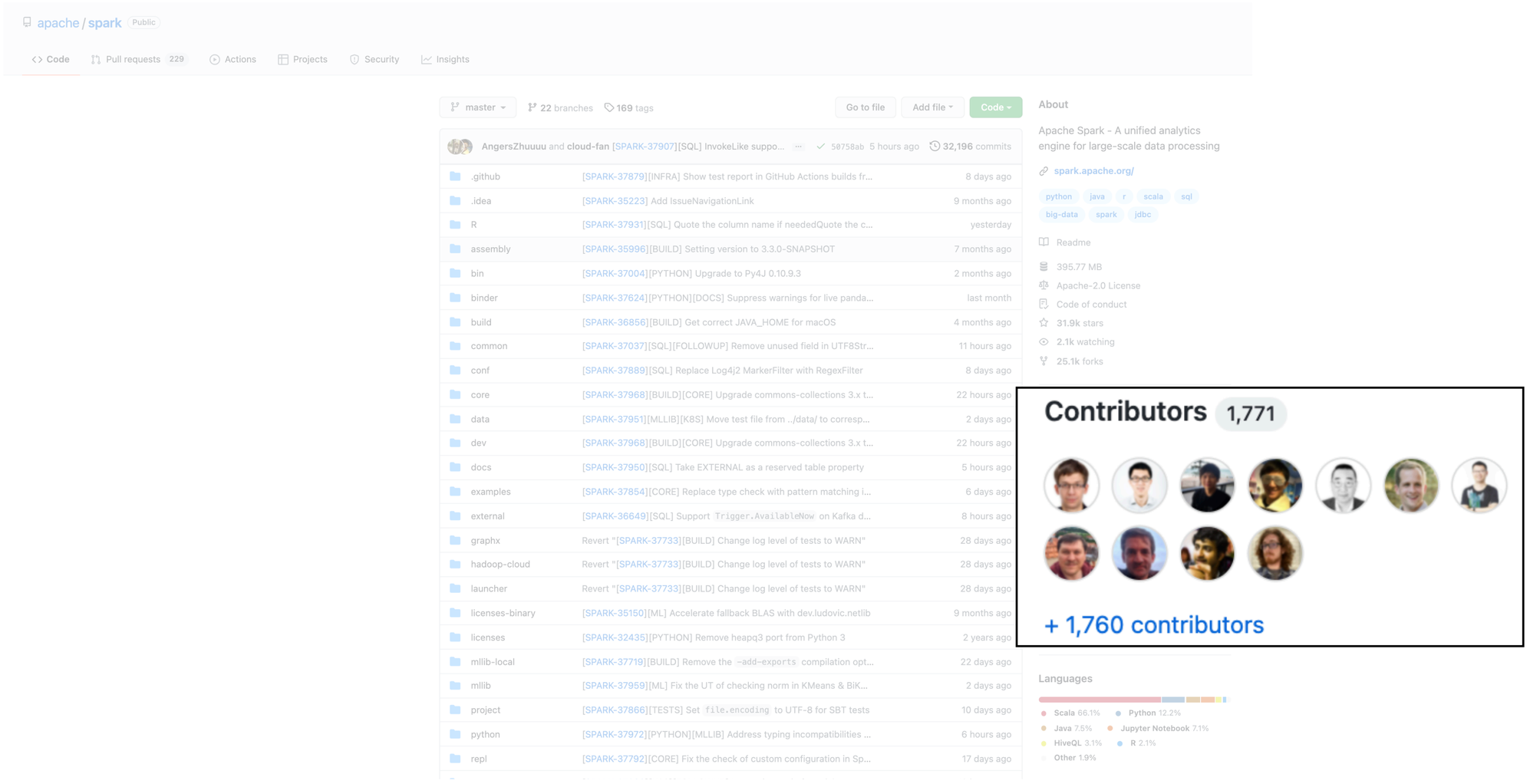
Complex **multi-language** software

Margaret Hamilton's Apollo code

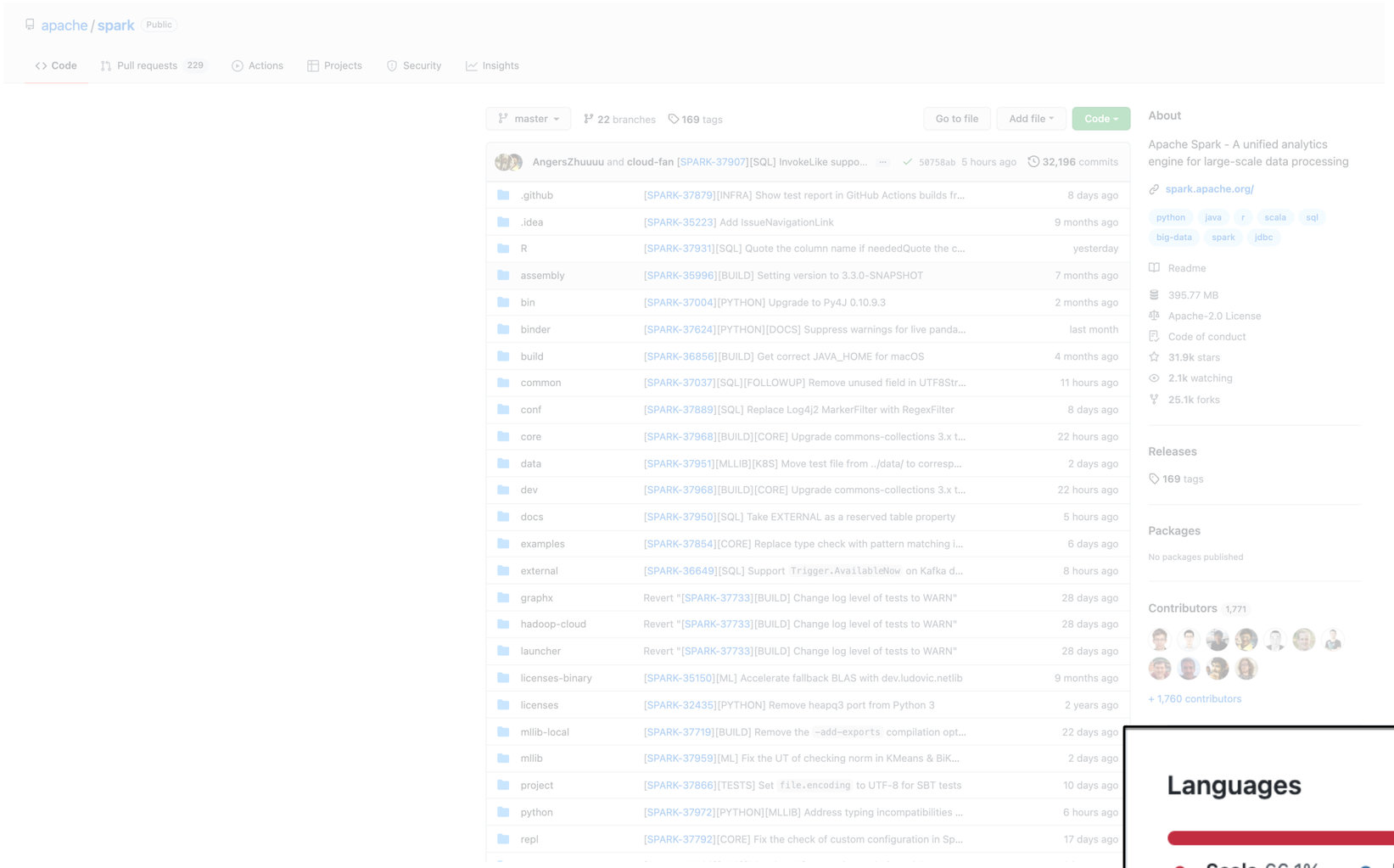


Compare it to Apollo 11 mission: to the moon with 4 KB of RAM

Complex **multi-language** software



Complex **multi-language** software

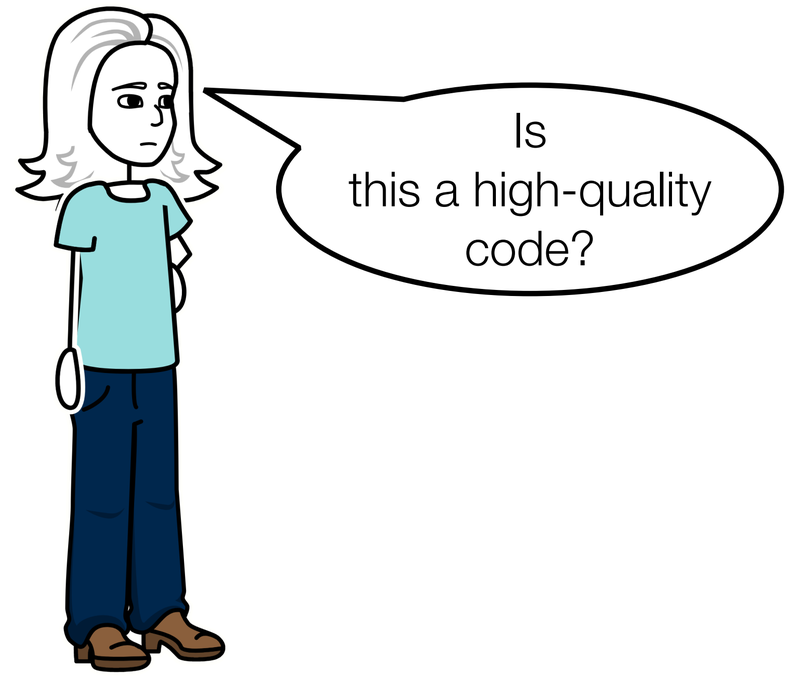


Source code

```java
package spicetify;

import javafx.scene.Parent;
import javafx.scene.Scene;
import javafx.scene.image.Image;
import javafx.scene.image.ImageView;
import javafx.scene.layout.BorderPane;
import javafx.scene.paint.Color;
import javafx.stage.Stage;

public class HomeWindow extends BaseWindow{
    private ImageView logoView;
    private Parent root;
    private Scene scene;
    BaseWindow baseWindow = new BaseWindow();
    Sidebar sidebar = new Sidebar(baseWindow.getHeight(), 100, "#282828", root);

    public HomeWindow(){
        this.root = new BorderPane();
        this.logoView = new ImageView(new Image("file:src/main/resources/spicetify/images/essentials/logo.png"));
        this.scene = baseWindow.getScene();
    }

    public HomeWindow(int width, int height, String html){
        this.logoView = new ImageView(new Image("file:src/main/resources/spicetify/images/essentials/logo.png"));
        this.root = new BorderPane();
        this.scene = baseWindow.getScene();
        baseWindow.setWidth(width);
        baseWindow.setMinWidth(width);
        baseWindow.setHeight(height);
        baseWindow.setMinHeight(height);
        baseWindow.setHtmlColor(html);
    }


    public void start(Stage stage){
        root.setStyle("-fx-background-color: transparent;");
        ((BorderPane) root).setLeft(sidebar.getSidebar());
        baseWindow.transform(logoView, 600, 700, true);
```

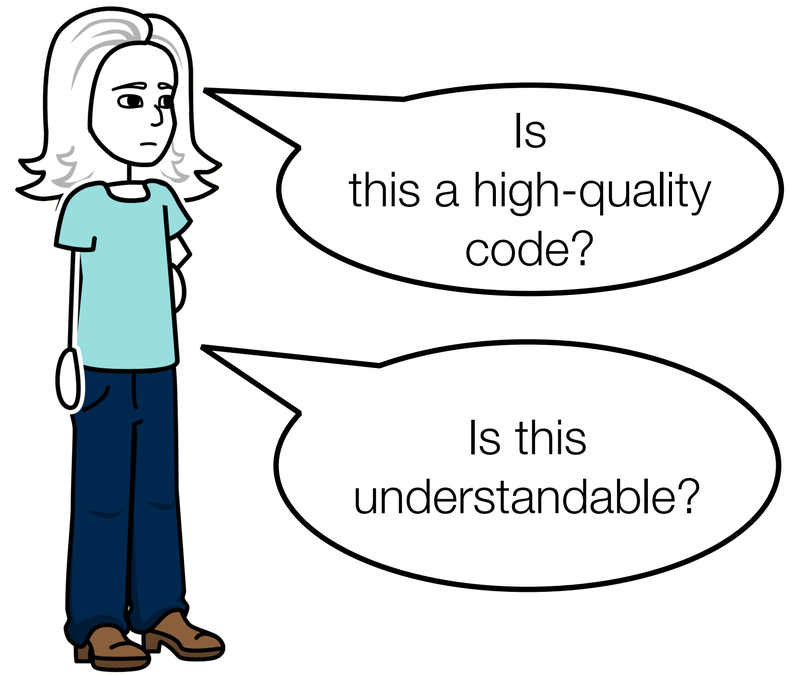
How to ensure its quality?

```java
package spicetify;

import javafx.scene.Parent;
import javafx.scene.Scene;
import javafx.scene.image.Image;
import javafx.scene.image.ImageView;
import javafx.scene.layout.BorderPane;
import javafx.scene.paint.Color;
import javafx.stage.Stage;

public class HomeWindow extends BaseWindow{
    private ImageView logoView;
    private Parent root;
    private Scene scene;
    BaseWindow baseWindow = new BaseWindow();
    Sidebar sidebar = new Sidebar(baseWindow.getHeight(), 100, "#282828", root);

    public HomeWindow(){
        this.root = new BorderPane();
        this.logoView = new ImageView(new Image("file:src/main/resources/spicetify/images/essentials/logo.png"));
        this.scene = baseWindow.getScene();
    }

    public HomeWindow(int width, int height, String html){
        this.logoView = new ImageView(new Image("file:src/main/resources/spicetify/images/essentials/logo.png"));
        this.root = new BorderPane();
        this.scene = baseWindow.getScene();
        baseWindow.setWidth(width);
        baseWindow.setMinWidth(width);
        baseWindow.setHeight(height);
        baseWindow.setMinHeight(height);
        baseWindow.setHtmlColor(html);
    }


    public void start(Stage stage){
        root.setStyle("-fx-background-color: transparent;");
        ((BorderPane) root).setLeft(sidebar.getSidebar());
        baseWindow.transform(logoView, 600, 700, true);
```

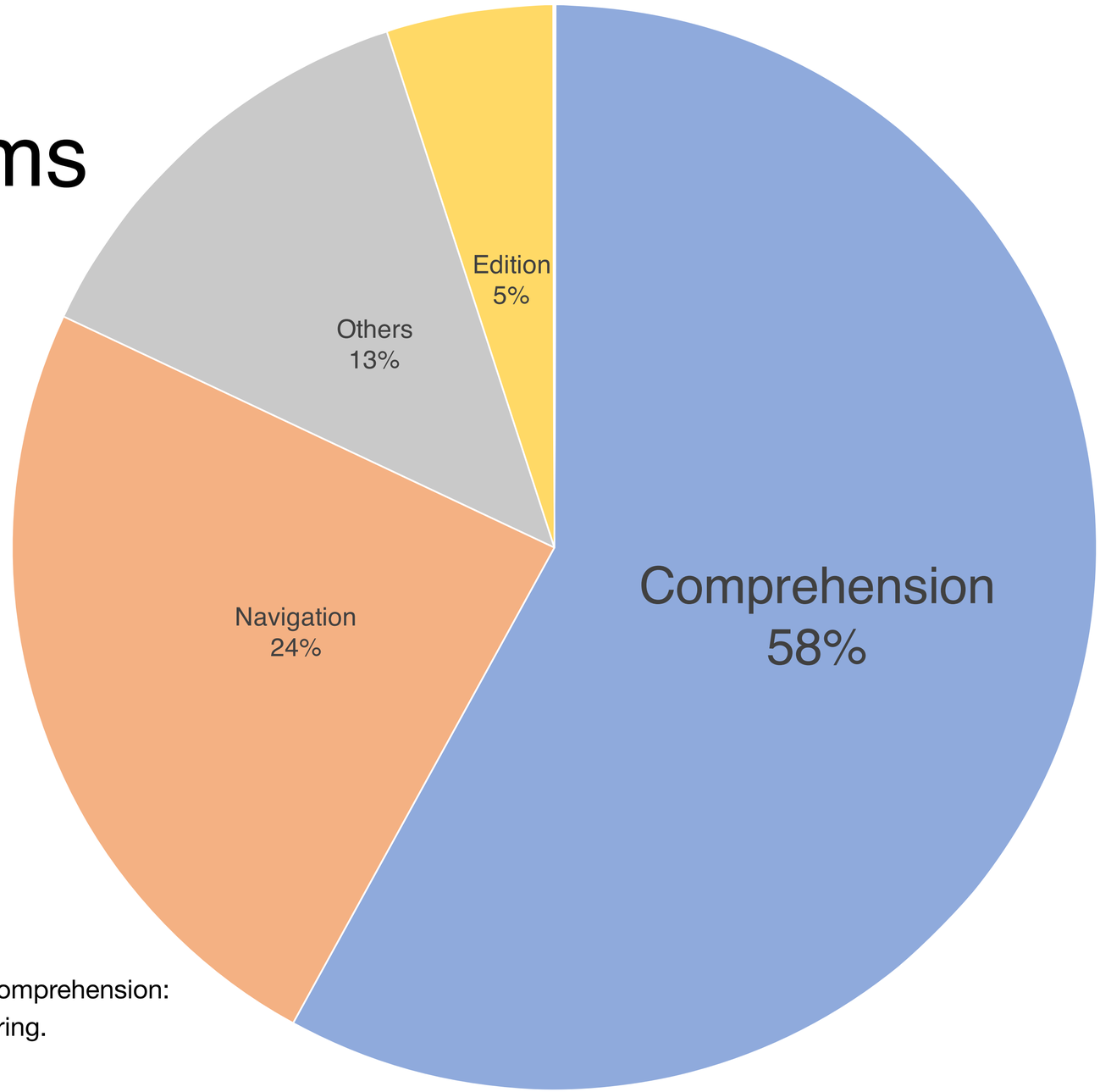


How to ensure its quality?

```java
package spicetify;

import javafx.scene.Parent;
import javafx.scene.Scene;
import javafx.scene.image.Image;
import javafx.scene.image.ImageView;
import javafx.scene.layout.BorderPane;
import javafx.scene.paint.Color;
import javafx.stage.Stage;

public class HomeWindow extends BaseWindow{
    private ImageView logoView;
    private Parent root;
    private Scene scene;
    BaseWindow baseWindow = new BaseWindow();
    Sidebar sidebar = new Sidebar(baseWindow.getHeight(), 100, "#282828", root);

    public HomeWindow(){
        this.root = new BorderPane();
        this.logoView = new ImageView(new Image("file:src/main/resources/spicetify/images/essentials/logo.png"));
        this.scene = baseWindow.getScene();
    }

    public HomeWindow(int width, int height, String html){
        this.logoView = new ImageView(new Image("file:src/main/resources/spicetify/images/essentials/logo.png"));
        this.root = new BorderPane();
        this.scene = baseWindow.getScene();
        baseWindow.setWidth(width);
        baseWindow.setMinWidth(width);
        baseWindow.setHeight(height);
        baseWindow.setMinHeight(height);
        baseWindow.setHtmlColor(html);
    }


    public void start(Stage stage){
        root.setStyle("-fx-background-color: transparent;");
        ((BorderPane) root).setLeft(sidebar.getSidebar());
        baseWindow.transform(logoView, 600, 700, true);
```



Software developers spend majority of their in understanding programs



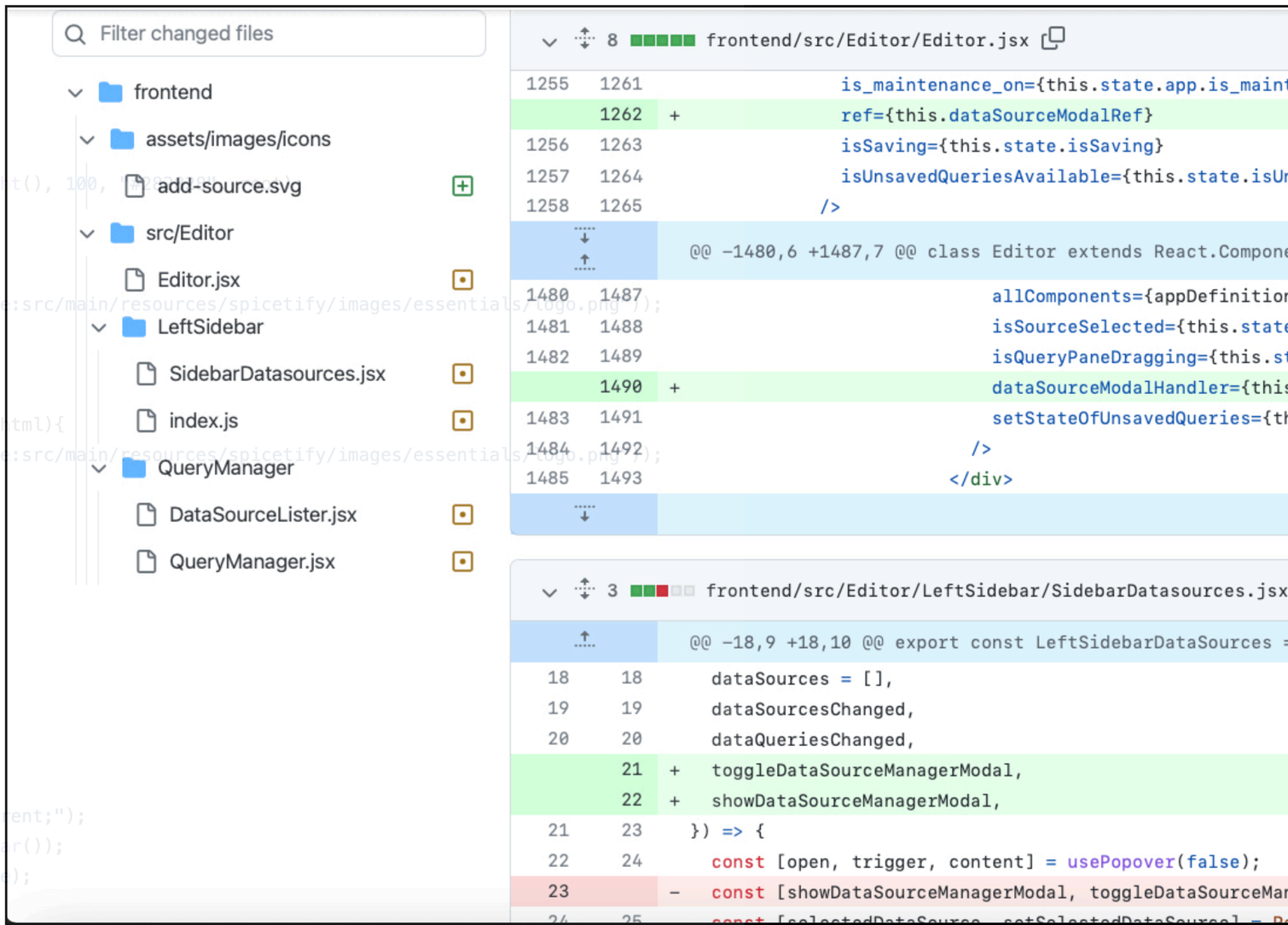
Xia, X., Bao, L., Lo, D., Xing, Z., Hassan, A. E., & Li, S. (2017). Measuring program comprehension: A large-scale field study with professionals. IEEE Transactions on Software Engineering.

Check code documentation

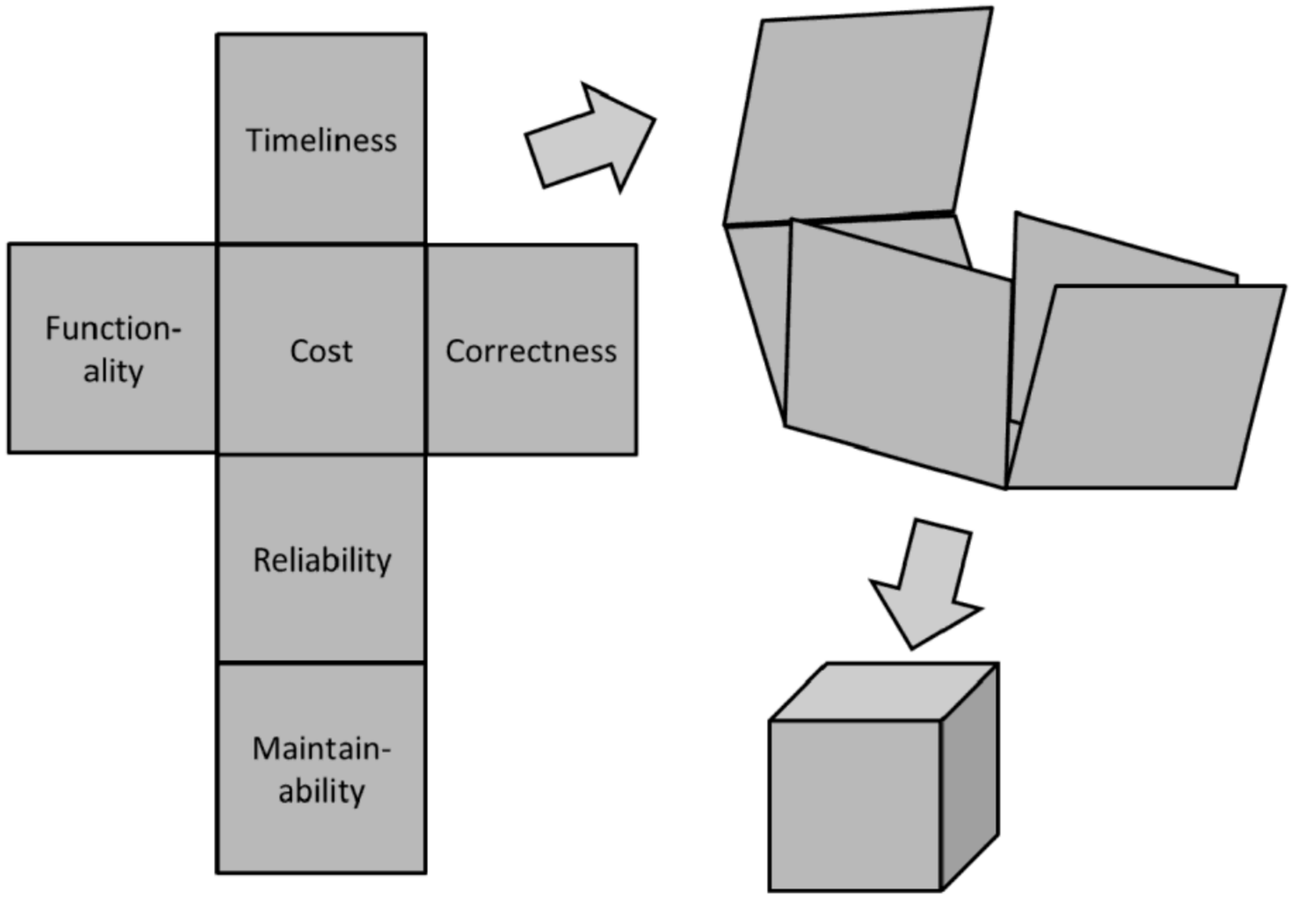
```java
/**
 * A class representing a window on the screen.
 *
 * For example:
 * <pre>
 *    HomeWindow win = new HomeWindow(parent);
 *    win.show();
 * </pre>
 *
 * @author Sami Shaio
 * @version 1.13, 06/08/06
 * @see java.awt.BaseWindow
 * @see java.awt.Button
 */
class HomeWindow extends BaseWindow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

```
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, 
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);
32         baseWindow.setHtmlColor(html);
33     }
34
35
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);
```

Peer code review

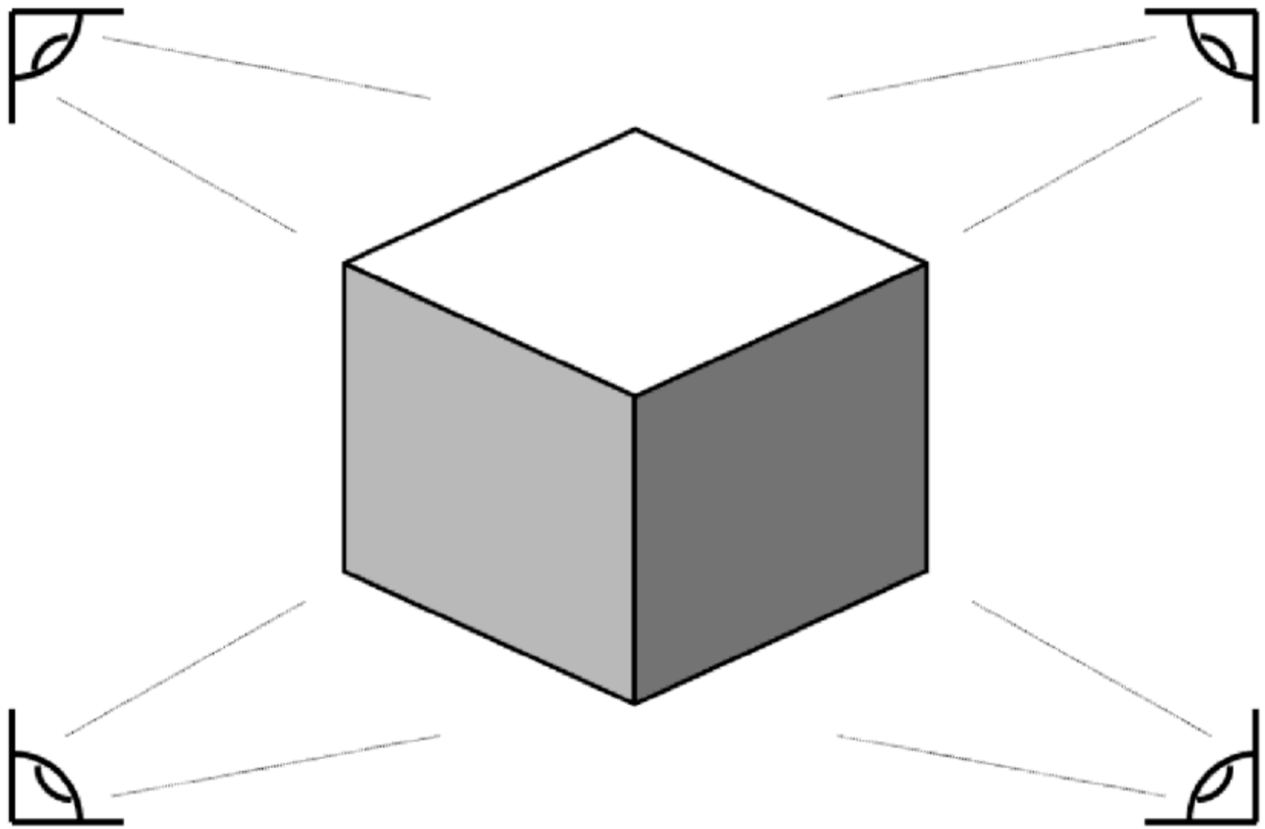


Quality is a multi-dimensional concept



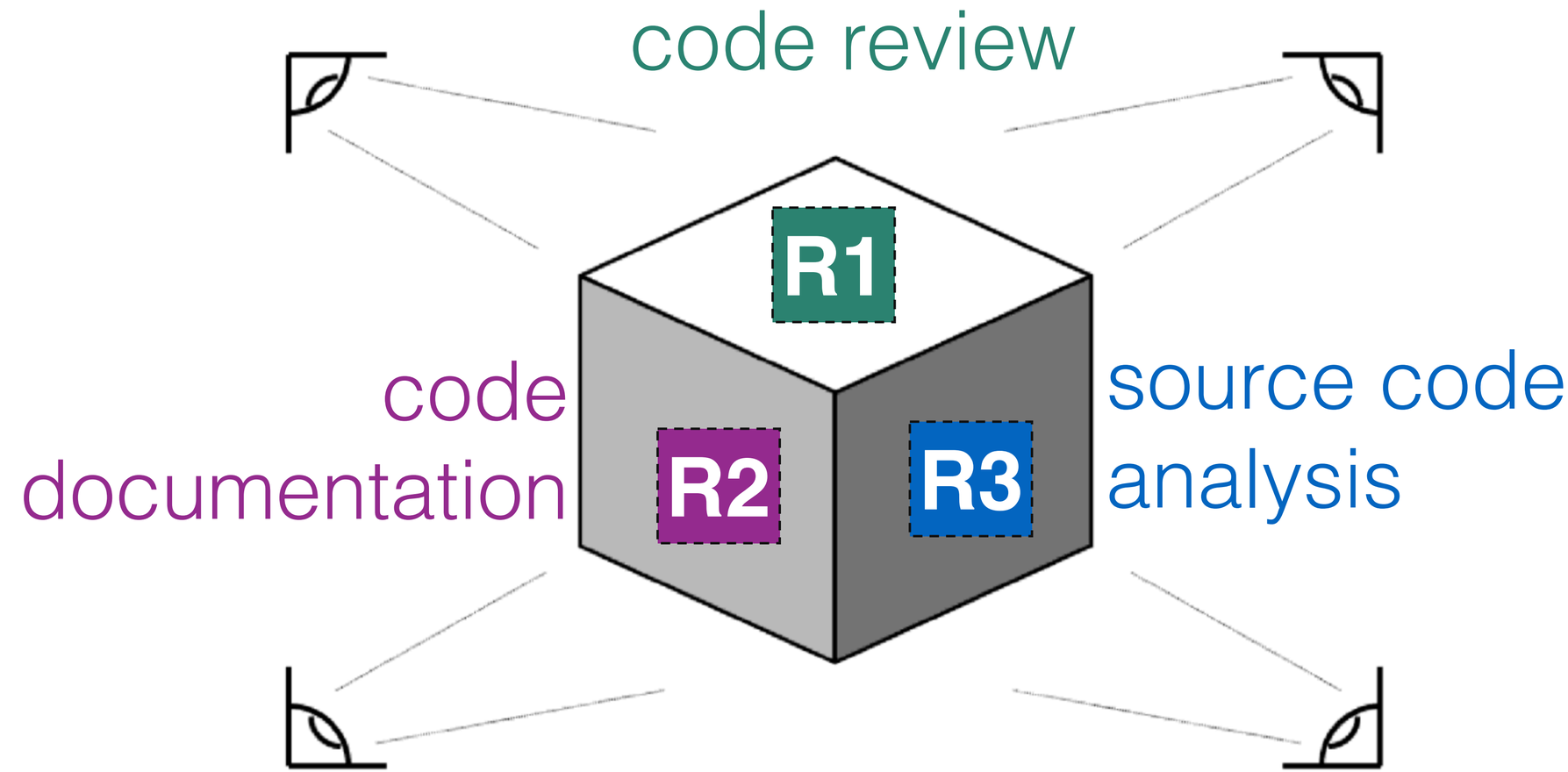
Gillies et al. 2011

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

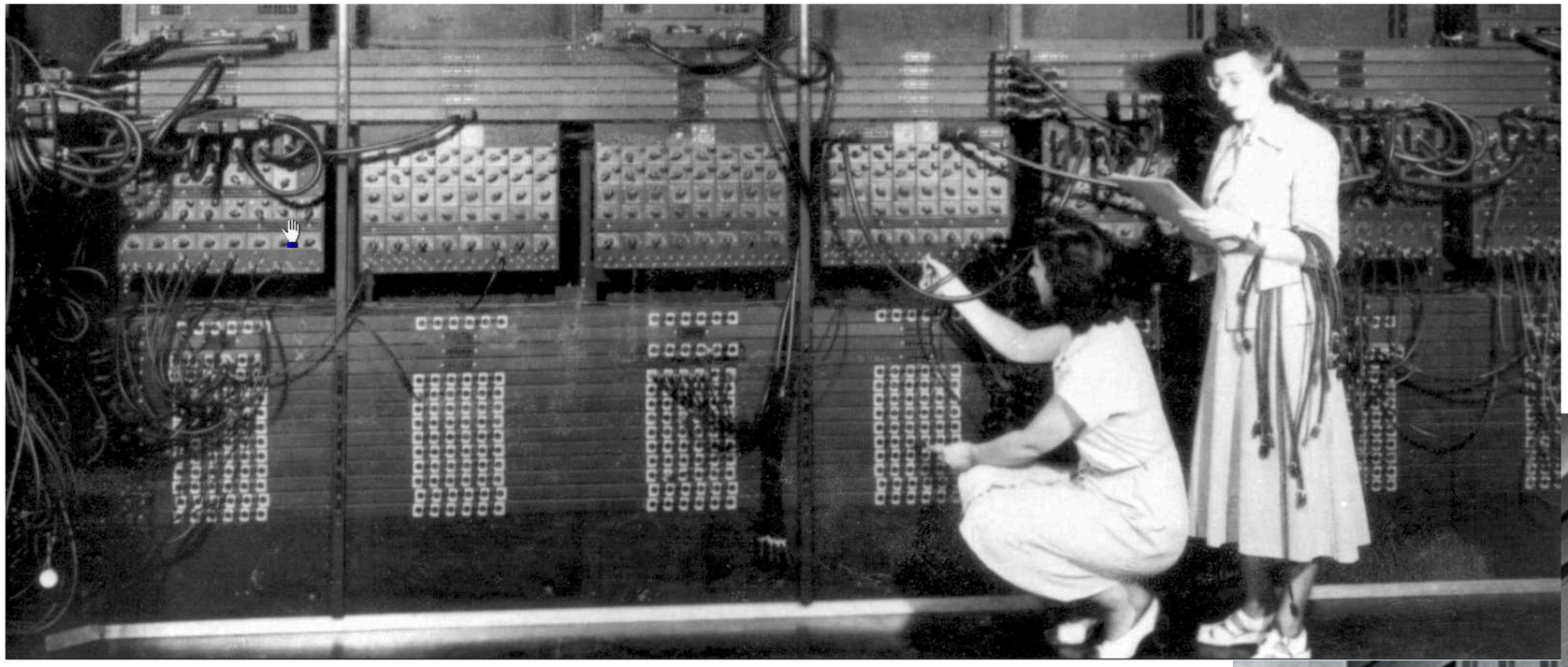
Awareness

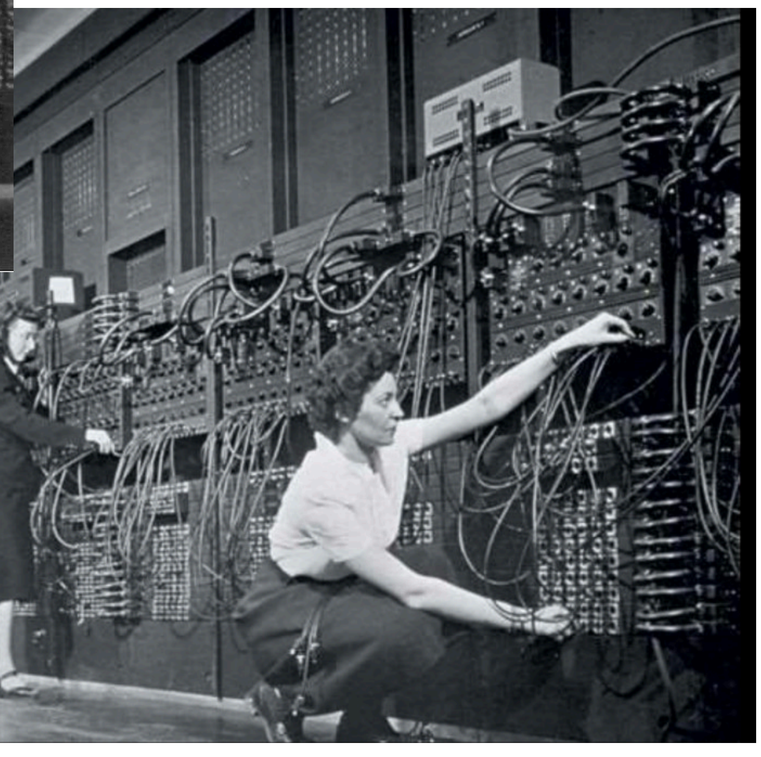
How did we reach here?

Culture

Personality

We had stereotypes





When Computer Coding was a ‘Woman’s’ Job

https://www.history.com/news/coding-used-to-be-a-womans-job-so-it-was-paid-less-and-undervalued

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

https://www.computerhistory.org/babbage/adalovelace/

https://www.history.com/news/coding-used-to-be-a-womans-job-so-it-was-paid-less-and-undervalued

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."

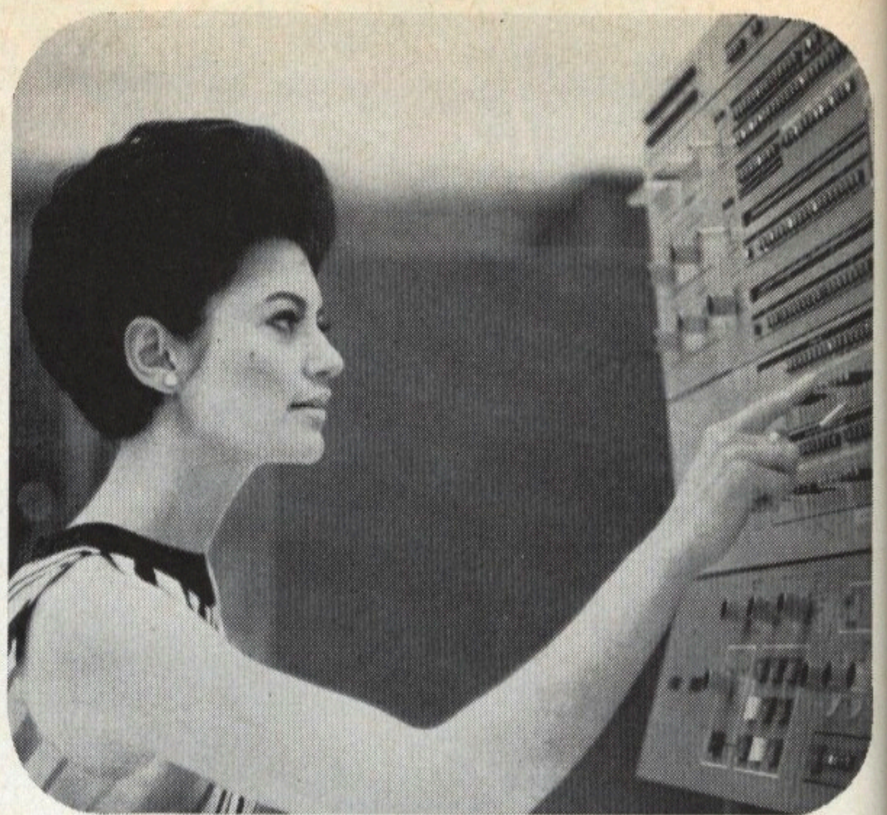
What she's talking about is *aptitude*—the one most important quality a girl needs to become a programmer. She also needs a keen, logical mind. And if that zeroes out the old Billie Burke-Gracie Allen image of femininity, it's about time, because this is the age of the Computer Girls. There are twenty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

Photos by Henry Grossman. Dress by Gino Charles.

52

http://thecomputerboys.com/wp-content/uploads/2011/06/cosmopolitan-april-1967-1-large.jpg

Women are ‘naturals’ at computer programming



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

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

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 Com-

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

https://www.nsf.gov/statistics/seind14/

Varma, R. Indian women and mathematics for computer science. IEEE Technology and Society Magazine 30, 1 (Spring 2011), 3946.

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

https://www.history.com/news/coding-used-to-be-a-womans-job-so-it-was-paid-less-and-undervalued