Project Management

Lecture 5

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(Using materials created by N. Walkinshaw and R. Craggs)

Overview

- About Measurement
- Measurement under White Box:
  - Lines of code
  - Cyclomatic Complexity
- Measurement under Black Box:
  - Planning Poker
- Software Laws:
  - Patents, Copyright, Contract, Privacy

Measurement is Central to Quality

- How to plan for the project time and effort?
  - For the team?
  - For the customer?

- Which software/part of it needs more time for testing?

- Which developer should get a bonus payment for productivity?....

> “You cannot **control** what you cannot measure.”

Tom DeMarco, 1982

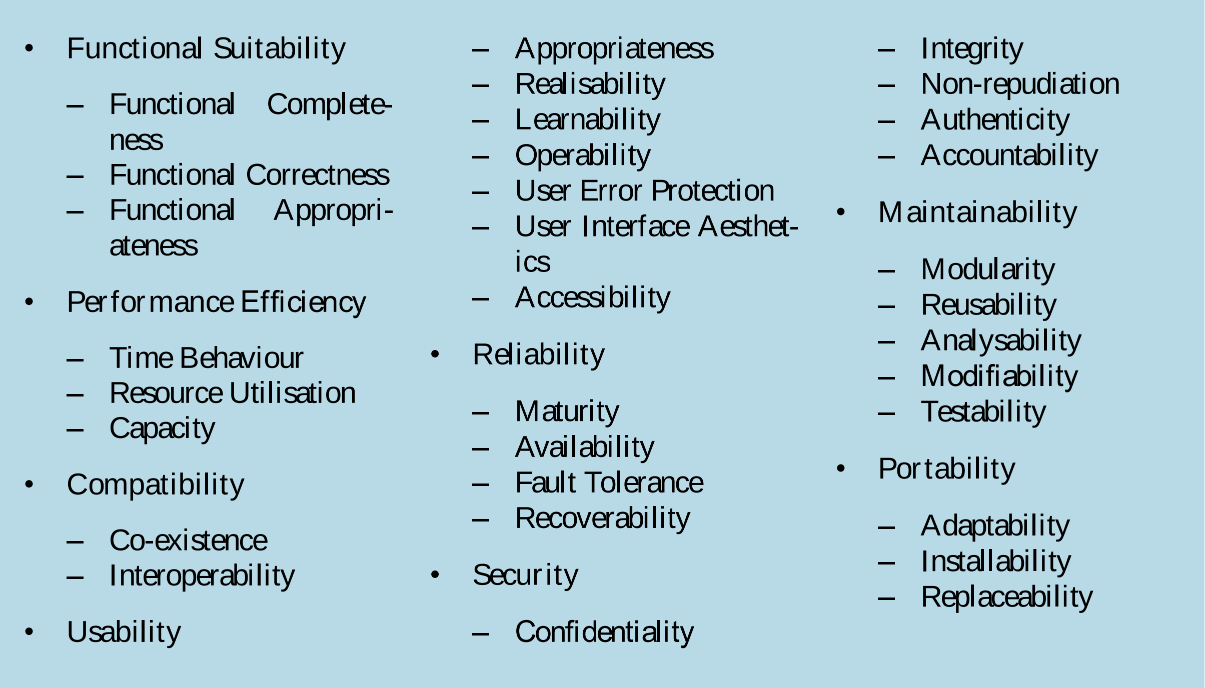
What is “Measurement”?

- Attributing values to objects.
    - The fuel efficiency of a car (gallons per mile)
    - The number of goals scored by a footballer
    - The cost of a house
- Can use these values as basis for comparison
    - What is the cheapest house?
    - Who is the best goal scorer?
- Can use these measurements and comparisons to **make better decisions**.
    - Which car should I buy (e.g., given five candidate cars)
    - Which striker should I put in my team?

Measurement is Difficult in Software Engineering

- Most entities are difficult to measure reliably
- Difficult or impossible to “pin down” a single value

E.g., Software Quality (ISO/IEC 25010):



- Functional Suitability
  - Functional Completeness
  - Functional Correctness
  - Functional Appropriateness
- Performance Efficiency
  - Time Behaviour
  - Resource Utilisation
  - Capacity
- Compatibility
  - Co-existence
  - Interoperability
- Usability
  - Appropriateness
  - Realisability
  - Learnability
  - Operability
  - User Error Protection
  - User Interface Aesthetics
  - Accessibility
- Reliability
  - Maturity
  - Availability
  - Fault Tolerance
  - Recoverability
- Security
  - Confidentiality
  - Integrity
  - Non-repudiation
  - Authenticity
  - Accountability
- Maintainability
  - Modularity
  - Reusability
  - Analysability
  - Modifiability
  - Testability
- Portability
  - Adaptability
  - Installability
  - Replaceability

Usual Metrics: Size and Complexity

- After development ...
  - How much effort will it require for maintenance?
  - Where should we direct testing effort?
  - How much effort was required for development?
  - Metrics are based upon source code (“white box”)

- Before development has started ...
  - How much programming effort will module X require?
  - What will be the estimated cost of the final product?
  - Metrics are based upon requirements / specification (“black box”)

White Box Complexity Metrics

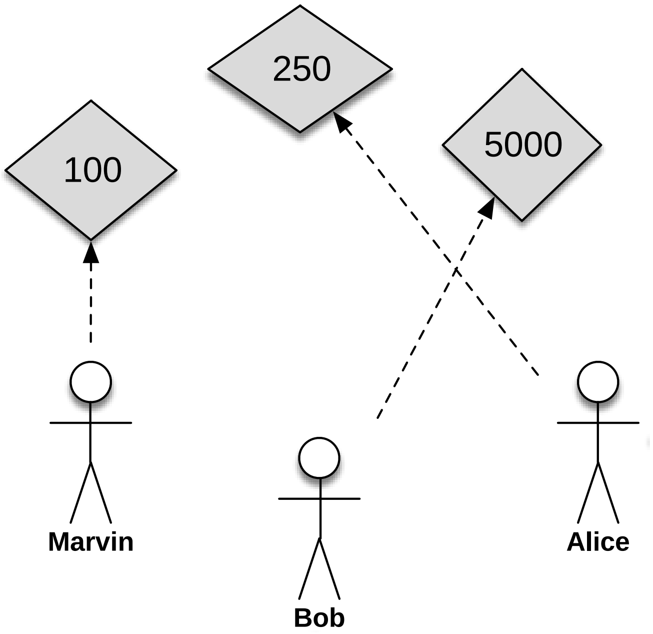
Number of lines in a file (or a group of files)

- Easy to compute
- Easy to understand and interpret
- Often sufficient for an approximate measure of size
- Widely used (perhaps the most widely used) metric

- Comments
- What is a line?
- Blank lines
- Not all “lines” are equal
- Ignores logical/ architectural complexity
- Highly language-specific

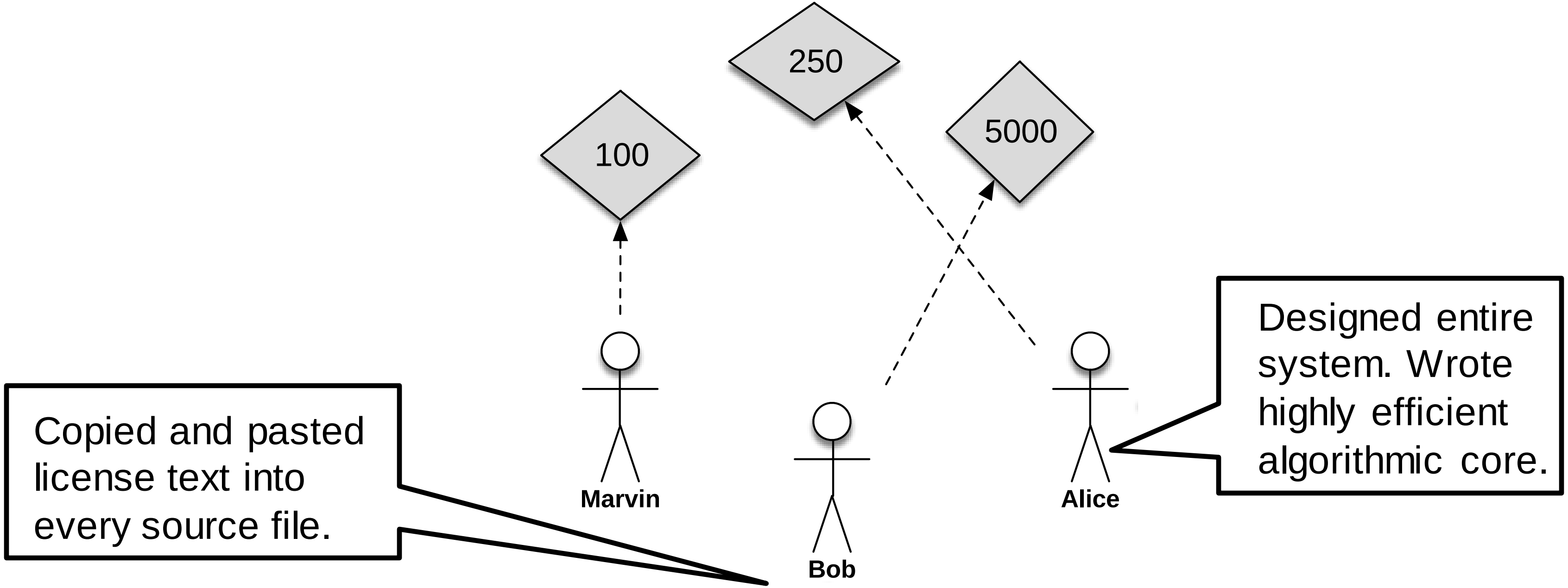
Example: Who is the most productive programmer?

Measured in lines of code



Example: Who is the most productive programmer?

Measured in lines of code



Copied and pasted license text into every source file.

Designed entire system. Wrote highly efficient algorithmic core.

Cyclomatic Complexity

The cyclomatic complexity of a code section is the quantitative measure of the number of linearly independent paths in it. It is a software metric used to indicate the complexity of a program. It is computed using the Control Flow Graph of the program.

- Calculated from the control flow graph:

  V(G) = E – N + 2P

  E – number of edges;

  N – number of nodes;

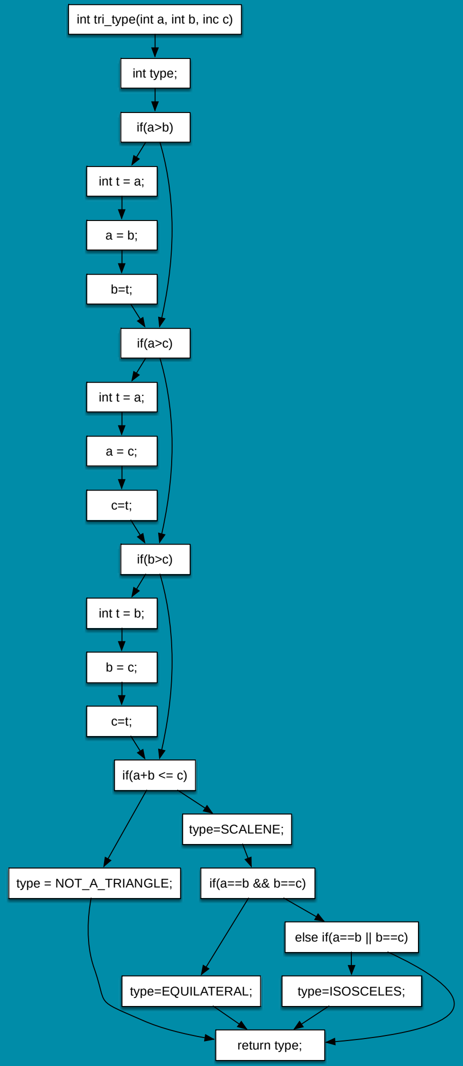
  P – number of procedures (usually 1)

Nodes = shapes in the control flow graph;
Edges = lines in the control flow graph.

- Number of independent paths through the code
- Independent path – any path that introduces at least one new statement/condition

Triangle Example

```
int tri_type(int a, int b, int c) {
  int type;
  if (a > b)
    { int t = a; a = b; b = t; }
  if (a > c)
    { int t = a; a = c; c = t; }
  if (b > c)
    { int t = b; b = c; c = t; }
  if (a + b <= c)
    type = NOT_A_TRIANGLE;
  else {
    type = SCALENE;
    if (a == b && b == c)
      type = EQUILATERAL;
    else if (a == b || b == c)
      type = ISOSCELES;
  }
return type;
}
```



int tri_type(int a, int b, inc c)

int type;

if(a>b)

int t = a;

a = b;

b=t;

if(a>c)

int t = a;

a = c;

c=t;

if(b>c)

int t = b;

b = c;

c=t;

if(a+b <= c)

type=SCALENE;

type = NOT_A_TRIANGLE;

if(a==b && b==c)

else if(a==b || b==c)

type=EQUILATERAL;

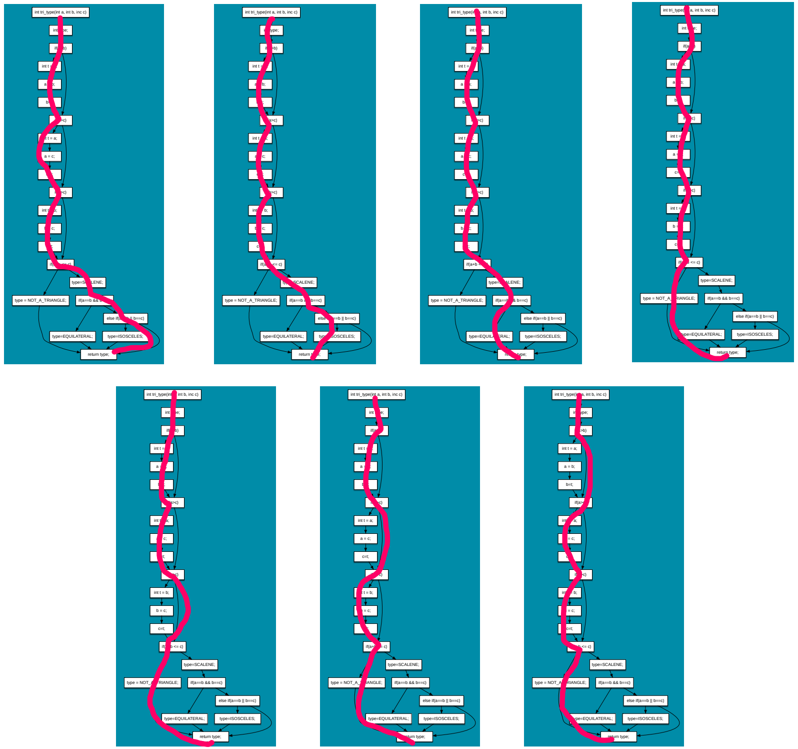
type=ISOSCELES;

return type;

Number of Edges = 27

Number of Nodes = 22

V = 27 – 22 + 2 = 7



Black Box Complexity Merics

Estimating Agile Projects

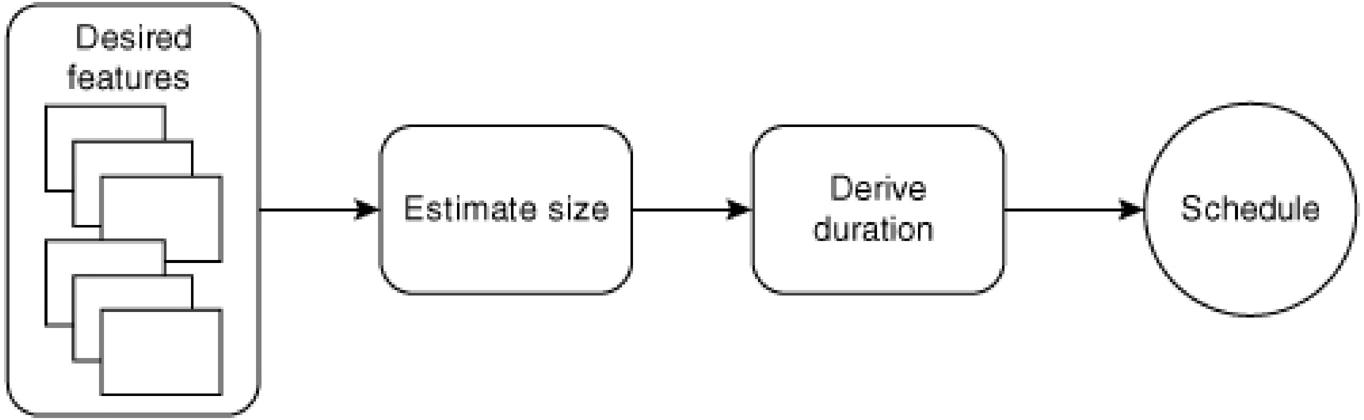


Figure from: Agile Estimating and Planning by Mike Cohn

Storey Points (Size Estimation)

Measurement of effort by the team members.

- An informal, agile unit of “size measurement”
  - Usually an estimate from 1-10
- Derive an estimate from the whole team at sprint planning meetings
- Based on the idea of the “Wisdom of the Crowds”
  - The collective estimate of groups (i.e., of effort required for a story) is better than the estimate of an individual

Accuracy vs Effort in Project Estimation

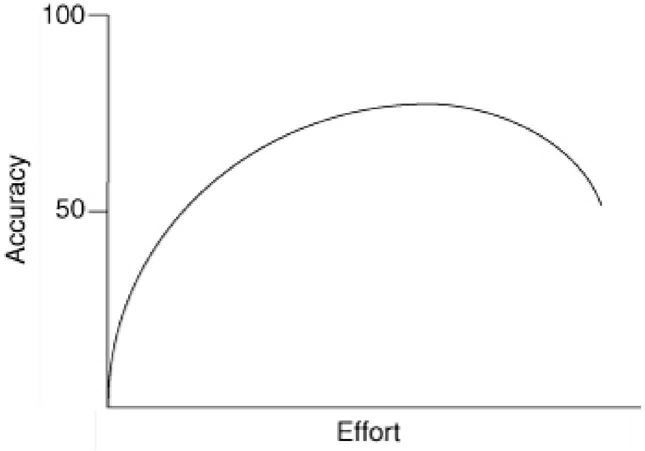
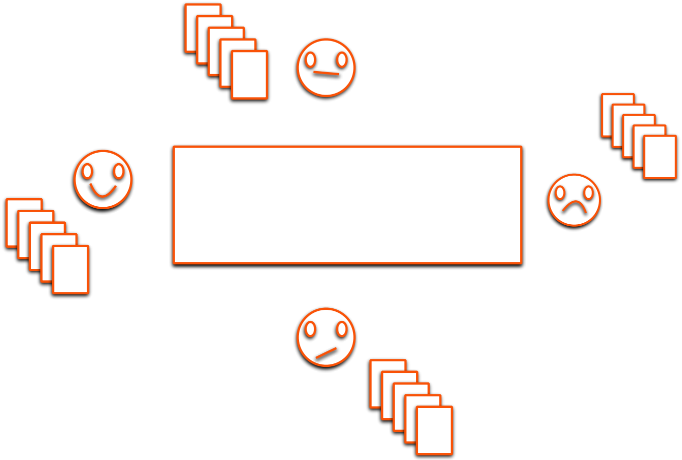


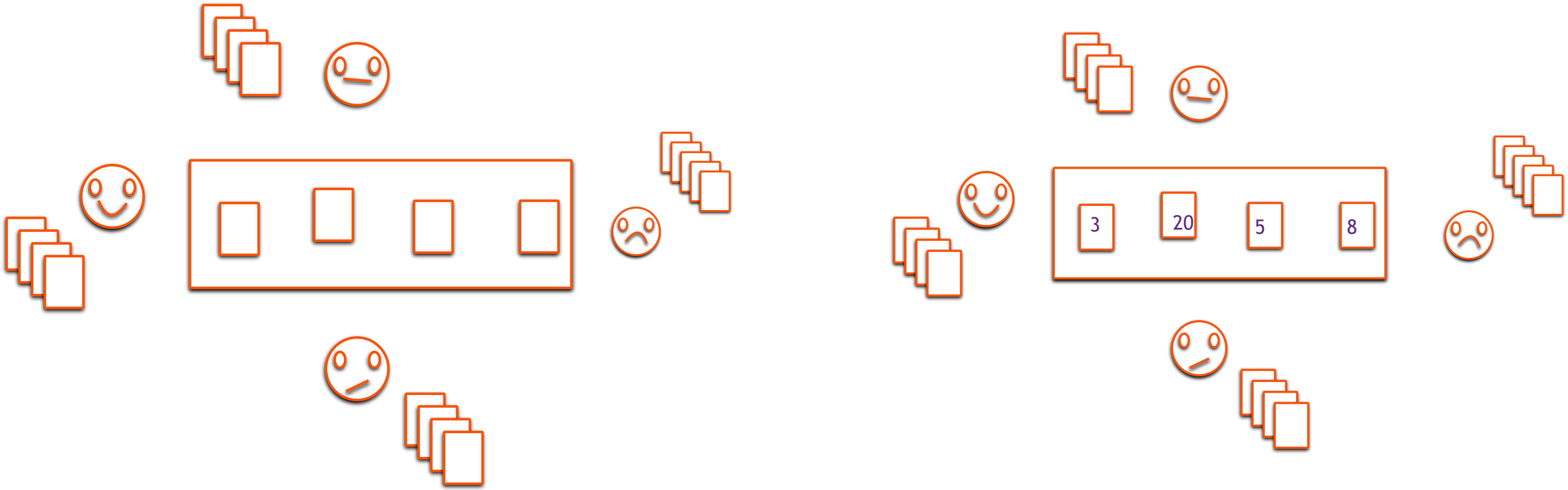
Figure from: Agile Estimating and Planning by Mike Cohn

Planning Poker

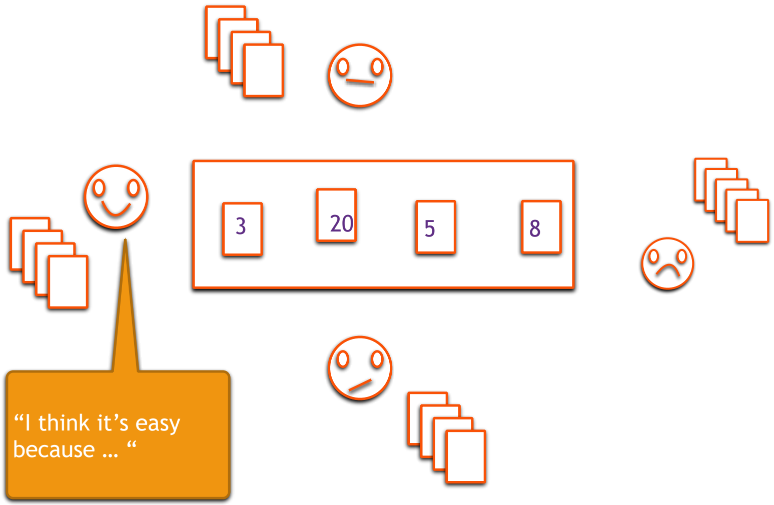
- The whole team is involved
- Each member is given a set of numbered cards
- Numbers follow the Fibonacci sequence
- 1,3,5,8,13,20,...
  - Larger tasks become harder to estimate in exact terms
  - Low values - trivial to implement
  - High values - difficult to implement
- Each member is also given a “?” card

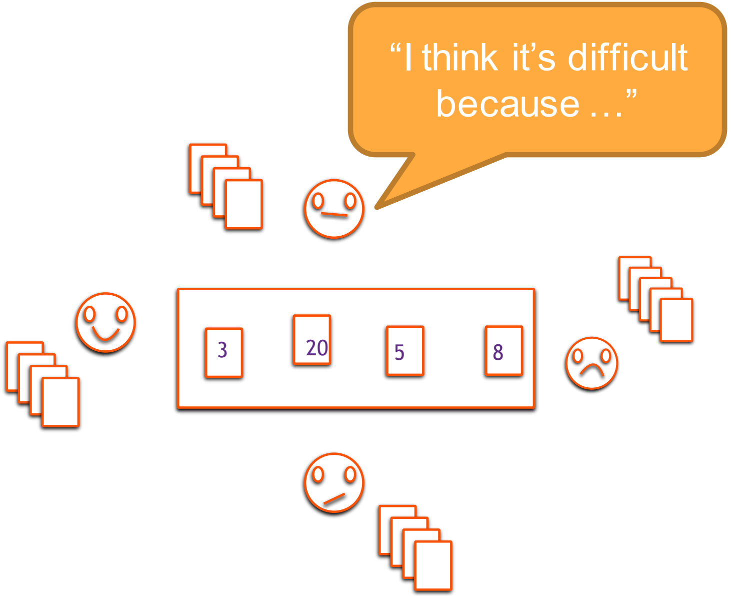


Planning Poker: Process



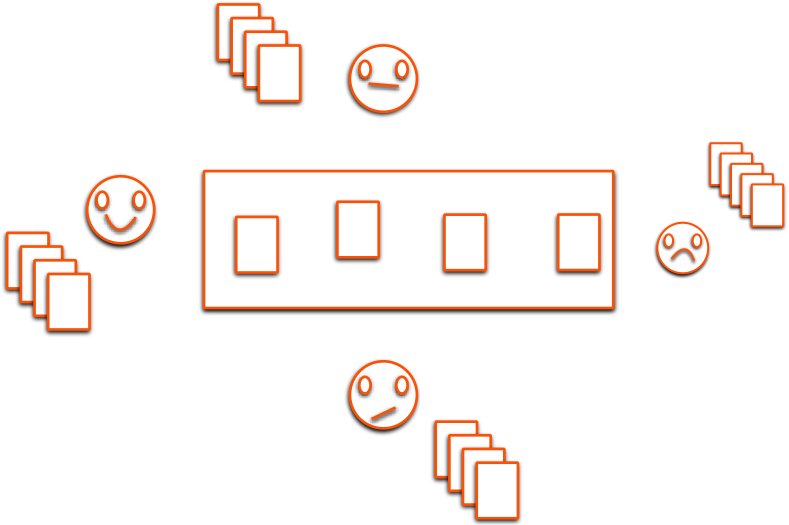
Planning Poker: Process

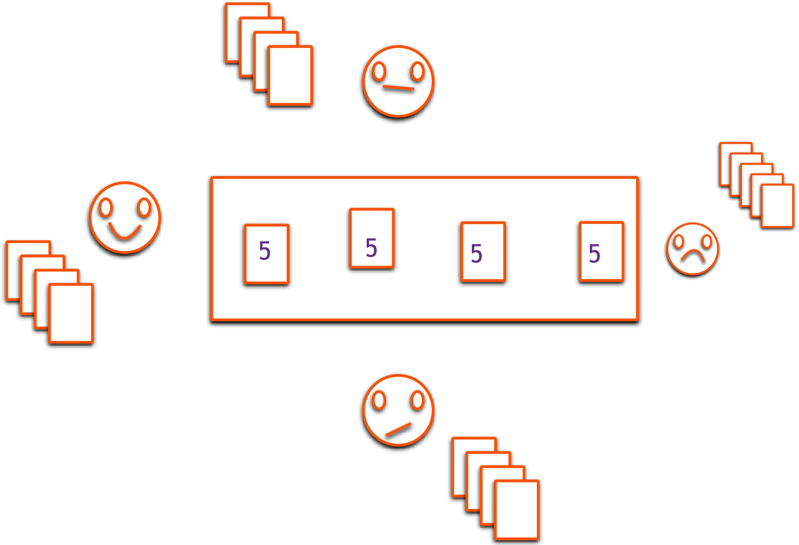




Planning Poker: Process

Cycle repeats for a maximum of 3 iterations (to avoid infinite loops!)

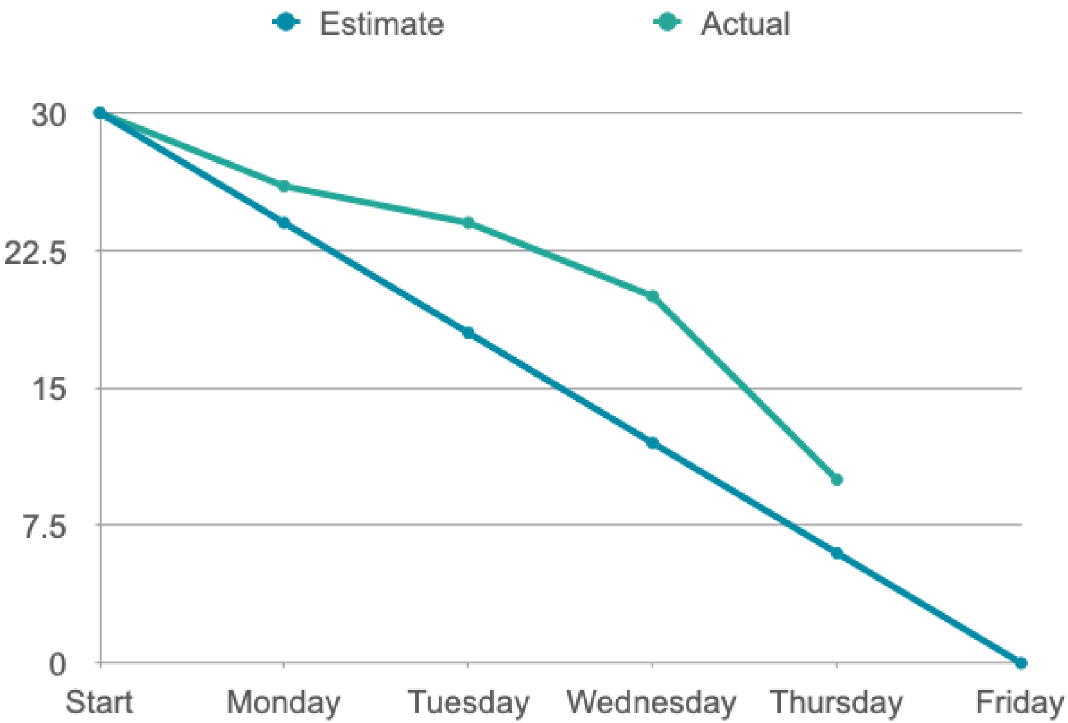




Team Velocity

- Number of (estimated) story points implemented per sprint.
- Can be derived from previous sprints.
  - e.g., Average points implemented from previous *x* sprints.
- Can be used to estimate:
  - Time required to complete project.
  - Target number of stories that can be completed in a sprint.

Burn Charts


Estimate
Actual
30
22.5
15
7.5
0
Start
Monday
Tuesday
Wednesday
Thursday
Friday

Software Laws: Patents, Copyright, Contract, Privacy

Patent Law

A government license giving a right for a set period, especially to exclude others from making, using, or selling an invention

- Granted by the government
- to stop others exploiting **your** invention
- Lasts 20 Year

Inventions Must

- be **new**
- be an **inventive** step (not an obvious improvement)
- capable of industrial application

The “Social Network”

Did Mark Zuckerberg infringe a patent?

- No patent was granted
- The idea was not new, social networks existed before this

Copyright

- Creator has **exclusive rights** to perform, copy, adapt their work.
- Everyone else must get **Permission** (and possibly pay)
- "literary, dramatic, musical and artistic works" **includes software**
- Automatically owned (not granted)
- Lasts **70 years** after authors death (lots of exceptions)

This affects software in 2 different ways:

- Illegal Copies of Applications (Piracy) !
- Using someone else's code/UI design/etc. in your application

(Not the "idea" but the actual "stuff" (code, design, documents) created by someone else)

Copyright Theft?

NO:

- Get permission (obtain a licence)
- Be within "fair use" (e.g. for study or review)
- Use "open source" software
- Create something similar yourself, independently
- "Obvious" code can't be copywrited

YES:

- Displaying an image from another page
- Using code found on the internet
- Copying Windows 95 for your friends

The “Social Network”

Did Mark Zuckerberg infringe copyright?

Maybe
- but there is no evidence he copied
- it it's not fair use
- it wasn't OSS
- he saw the code so didn't invent it himself

Contract Law

Employer contracts usually force an employee to:

- Not work for anyone else
- Hand over any ideas (Intellectual Property)
- Not disclose company secrets (Non-disclosure-agreements)

(even after you stop working for them)

The "Social Network"

Did Mark Zuckerberg break contract?

Probably Not

- there was no written contract
- he did not disclose any secrets about the other project

Data Protection

- **UK** : Data Protection Act
- **EU** : Data Protection Directive
- **US** : a "patchwork" of state and national laws

8 Principles of Data Protection:

Any company storing "personal data" must make sure it is:

- fairly and lawfully processed (consent, contractual and legal obligations, public interest, ...)
- processed for **limited purposes**;
- adequate, relevant and **not excessive**;
- accurate and, where necessary, kept up to date;
- not kept longer than necessary;
- processed in accordance with the data subject's rights;
- secure;

not transferred to countries without adequate protection

Review

- How can we measure complexity?
- Why do we use black box options?
- What is a patent
- What is the difference between patent and copyright?
- What do we learn about contract from Social Network?