maybe We Should Enable More Uncertain Mobile App Programming

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http://blue.cse.buffalo.edu/projects/maybe/

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```
String presenter = maybe "Ali Ben Ali", "Jerry Ajay";
```

Adaptation Today

```
if (batteryLevel < threshold) {
  // Sacrifice performance to save energy
} else {
  // Don't sacrifice performance
}
```

Adaptation Today

One threshold?

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Do the branches even work?

Adaptation Today

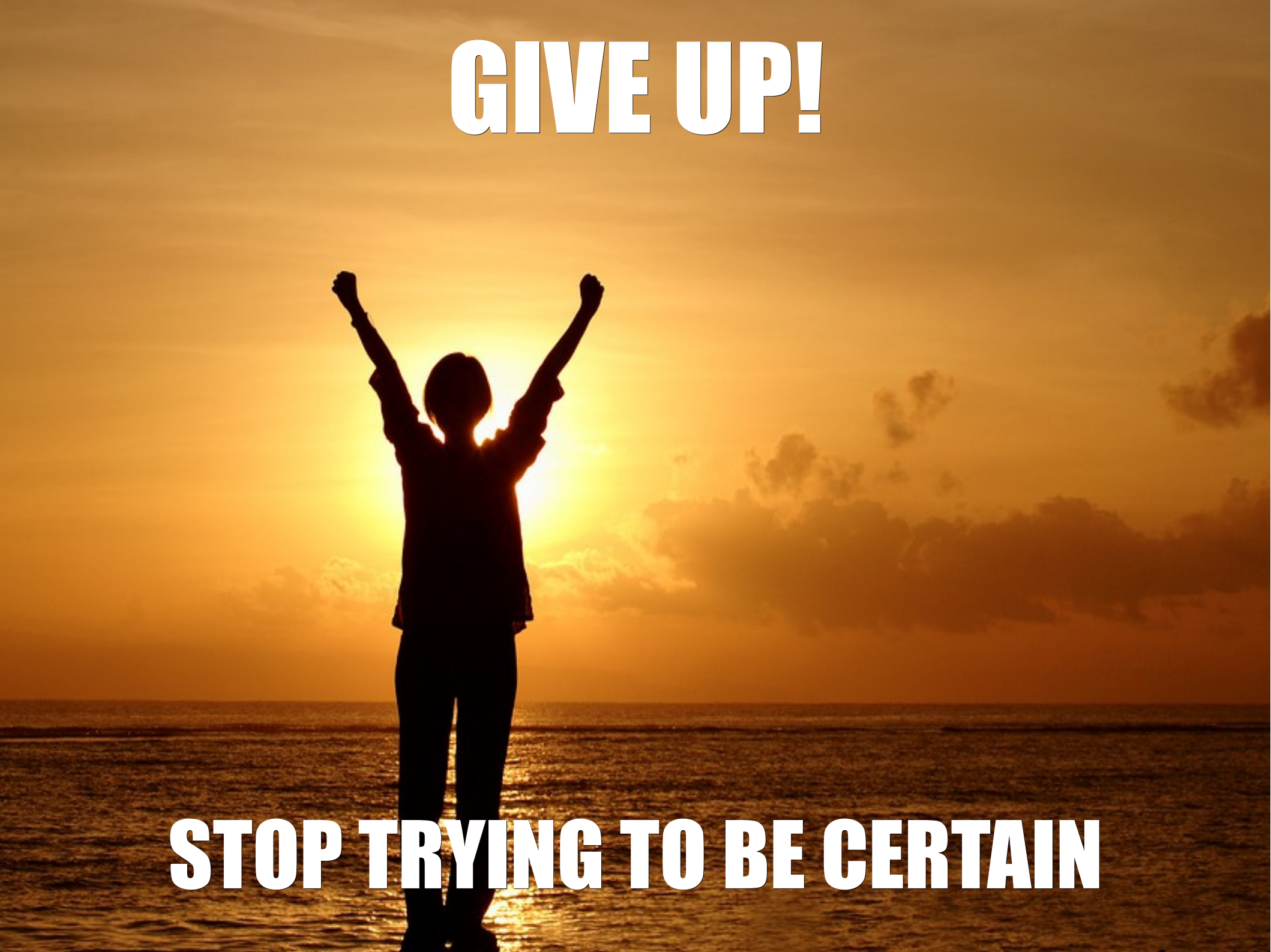
One threshold?

What threshold?

```
if (batteryLevel < threshold) {
  // Sacrifice performance to save energy
} else {
  // Don't sacrifice performance
}
```

And if so, how well?

Do the branches even work?


GIVE UP!
STOP TRYING TO BE CERTAIN

Adaptation Today

```
if (batteryLevel < threshold) {
  // Sacrifice performance to save energy
} else {
  // Don't sacrifice performance
}
```

Adaptation Tomorrow

```
maybe {
   // One way of doing something
} or {
   // Another way
}
```

`maybe` Block Syntax

```
maybe (“label”) {
  // Alternative 1
} or {
  // Alternative 2
}
...
} or {
  // Alternative n
}
```

`maybe` Block Syntax

```
maybe (“label”) {
   // Alternative 1
} or {
   // Alternative 2
}
...
} or {
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```

maybe Block Syntax

Label identifying the statement to the system

```
maybe (“label”) {
   // Alternative 1
} or {
   // Alternative 2
}
...
} or {
   // Alternative n
}
```

Multiple alternatives

`maybe` Assignment Syntax

```
String perf = maybe (“perf”) “low”, ”med”, ”high”;
```

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Multiple alternatives

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String perf = maybe (“perf”) “low”, ”med”, ”high”;
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`maybe` Assignment Syntax

Multiple alternatives

```
String perf = maybe (“perf”) “low”, ”med”, ”high”;

int timer = maybe (“timer”) 1-16;
```

Range shortcut

`maybe` Syntax and System

`maybe` statement: allows programmers to *express uncertainty*

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`maybe` system: uses testing and learning to *convert uncertainty to runtime certainty*

`maybe` Syntax and System

`maybe` statement: allows programmers to *express uncertainty*

`maybe` system: uses testing and learning to *convert uncertainty to runtime certainty*

Goal: know the best alternative at runtime

maybe Outcomes

```
maybe (“presenter”) {
   presenter = “Ali”;
} or {
   presenter = “Jerry”;
}
```

`maybe` Outcomes: Static

```
maybe (“presenter”) {
   presenter = “Ali”;
} or {
   presenter = “Jerry”;
}
```

User driven

`maybe` Outcomes: Static

```
maybe (“presenter”) {
   presenter = “Ali”;
} or {
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Geographic

`maybe` Outcomes: Dynamic

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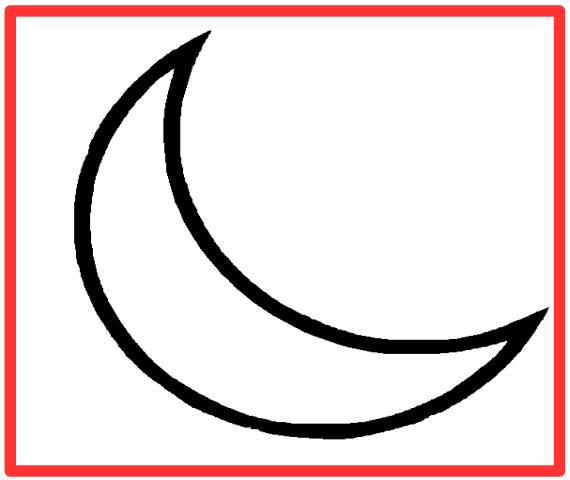
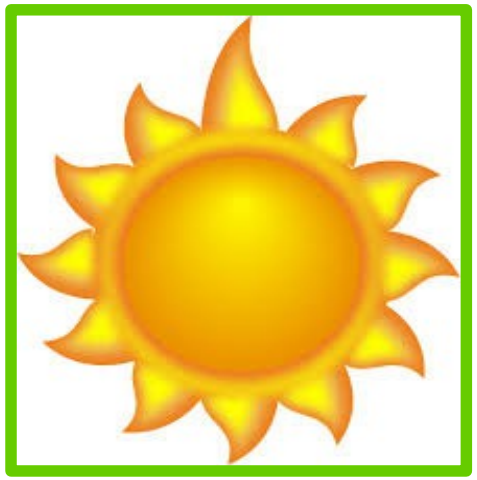


Temporal



maybe Outcomes: Dynamic

```
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```

Network based

maybe Outcomes: Dynamic

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maybe (“presenter”) {
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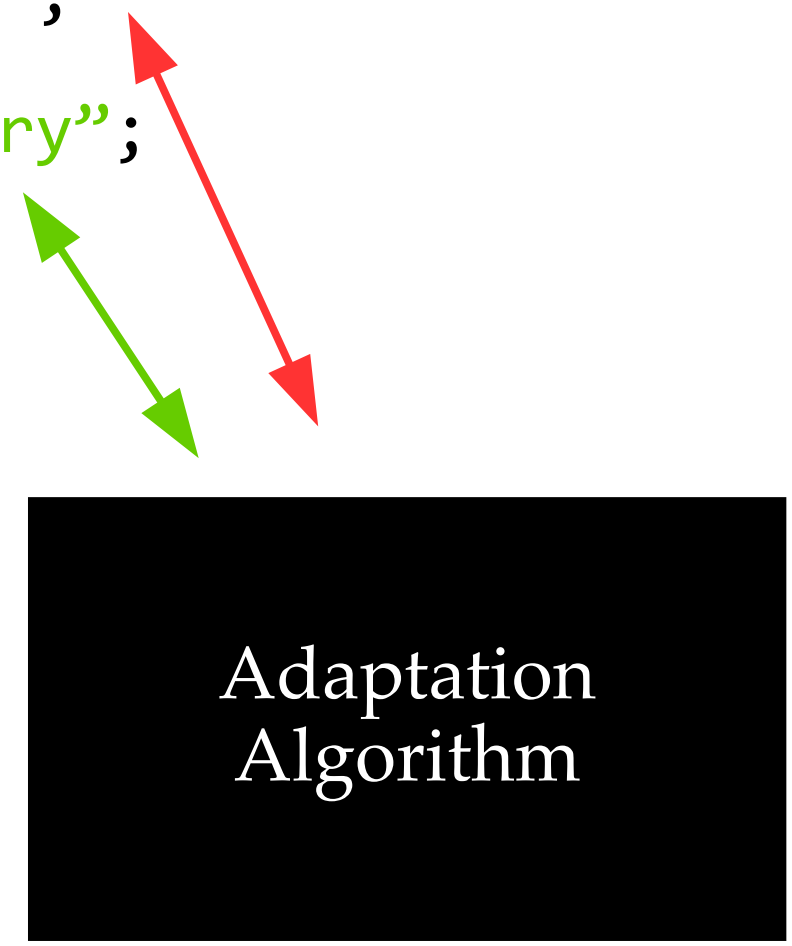

`maybe` Outcomes: Dynamic

```
maybe (“presenter”) {
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Developer controlled

maybe Testing

```
maybe (“presenter”) {
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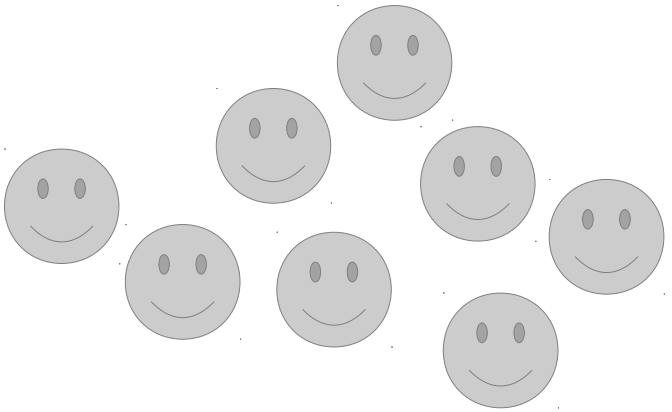

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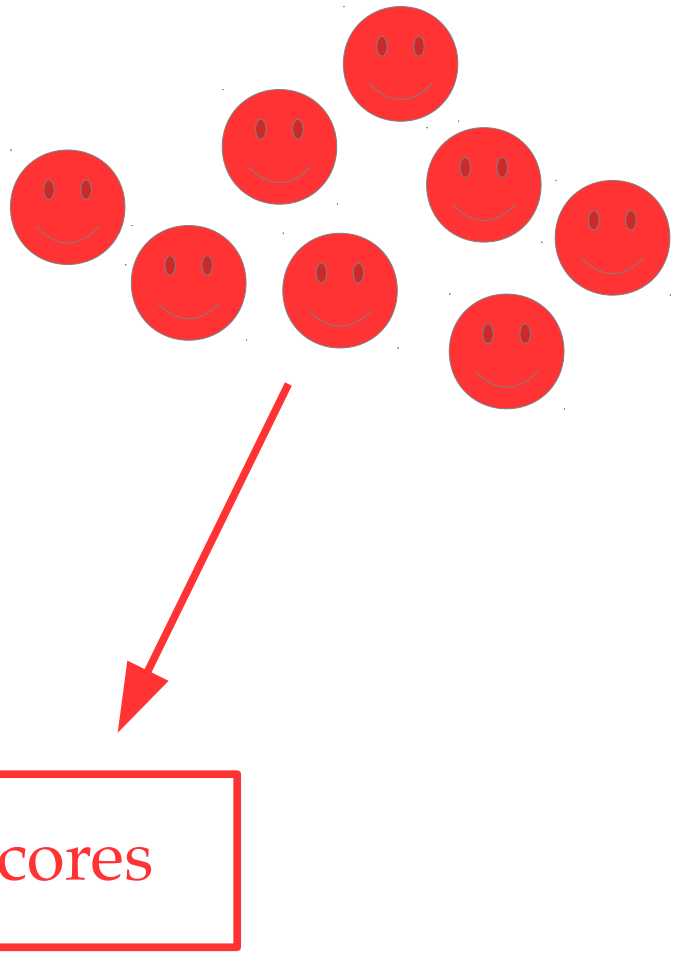

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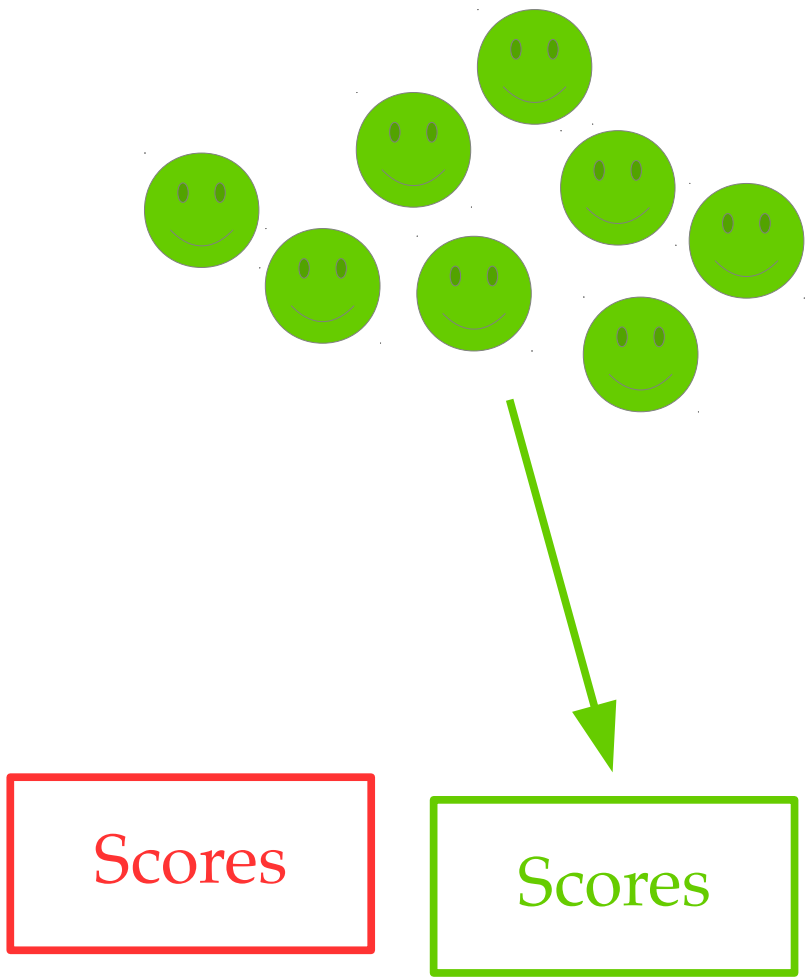

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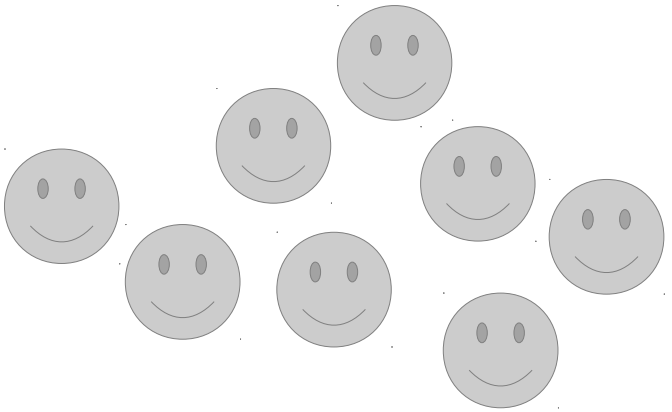

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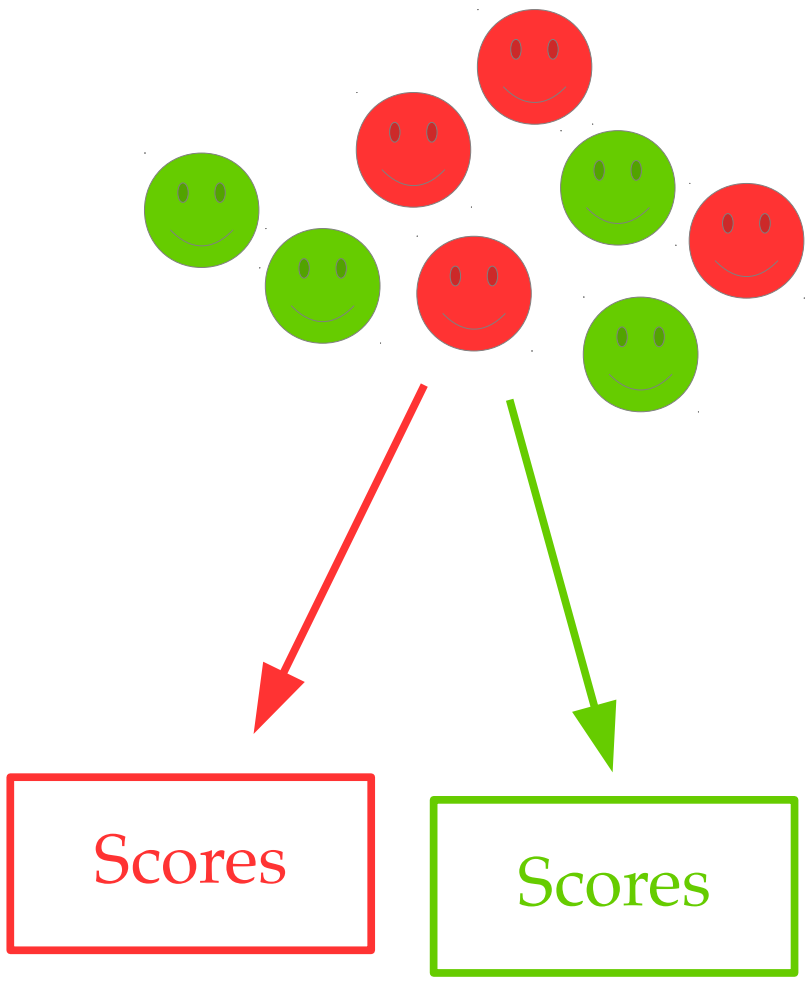

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}
```

Performance
Energy consumption

maybe Scoring: Custom

```
// Custom scoring initialization

maybe (“presenter”) {
  presenter = “Ali”;
} or {
  presenter = “Jerry”;
}

maybeService.addScore(“presenter”, JSON);
```

maybe Learning

```
maybe (“presenter”) {
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}
```

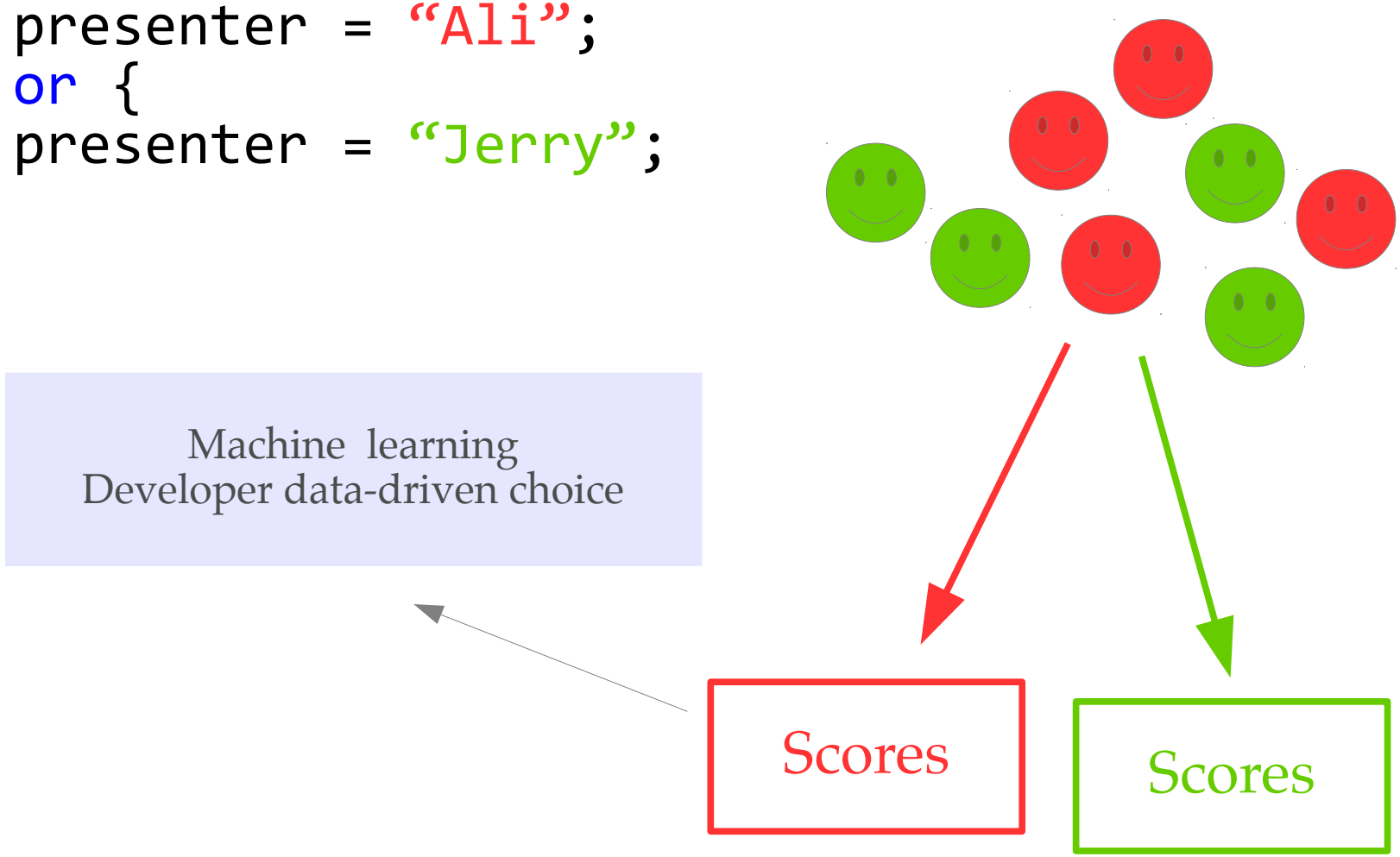

Inspiration: PhoneLab Data Collection

PhoneLab data collection tool

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PhoneLab data collection tool

- Multiple sources of uncertainty:
  - When and how often to upload data?
  - How often to rotate logs?
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```
int uploadMin = maybe (“upload”) 30, 60, 120;
```

Inspiration: Parking Lot Monitoring

PocketParker parking lot monitoring app

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- Relied on detecting transitions between walking and driving

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- Which is better?

```
maybe (“algorithm”) {
  initializeCustomAlgorithm();
} or {
  initializeGoogleAlgorithm();
}
```

Mining for Uncertainty

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Uncertainty hints:

- Timer rates
- Timeouts
- Cache sizes
- Performance-quality tradeoffs
- Attempts at battery level adaptation
- Any suggestions?

Current `maybe` Prototype

Rewrite-based implementation for Android Java

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Rewrite-based implementation for Android Java

- Preprocessor to rewrite `maybe` to existing conditional statements
- Android service to cache values and implement adaptation algorithms
- Backend server to drive testing, collect data and perform data analysis and learning
- Web interface to allow programmers to control the process

Summary: Embrace Uncertainty

- Forced certainty is a problem—particularly for mobile systems
- The `maybe` statement and system allow programmers to express and embrace uncertainty and activate testing and machine learning techniques

```
maybe (“findOutMore”) {
  http://blue.cse.buffalo.edu/projects/maybe
} or {
  http://www.stupidest_idea_ever.com
}
```