Procal

Programmable Scientific Calculator for Android L+

Daniel Cheung, Dipsy Wong, Bryan Chun, Peter Tse

Programmability

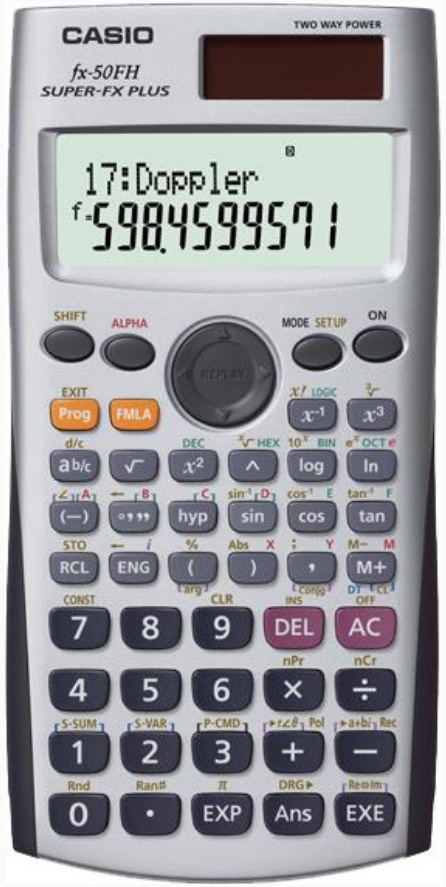
Flexible UI

Core Aims

Easy Transition

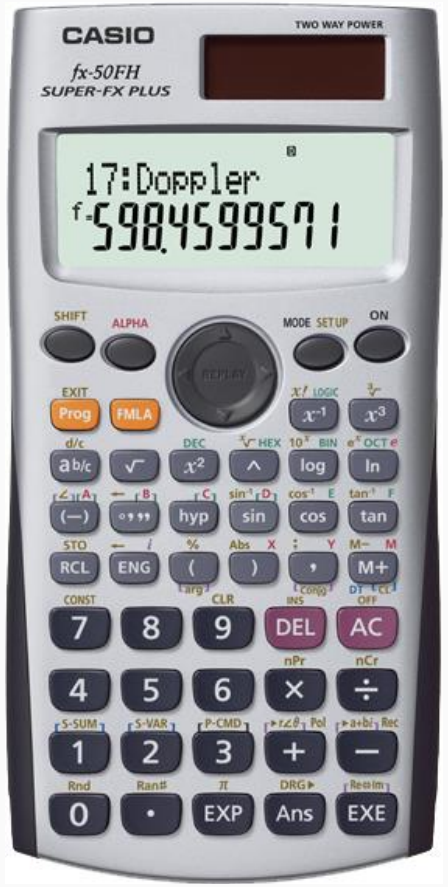
Easy Transition

Inspiration

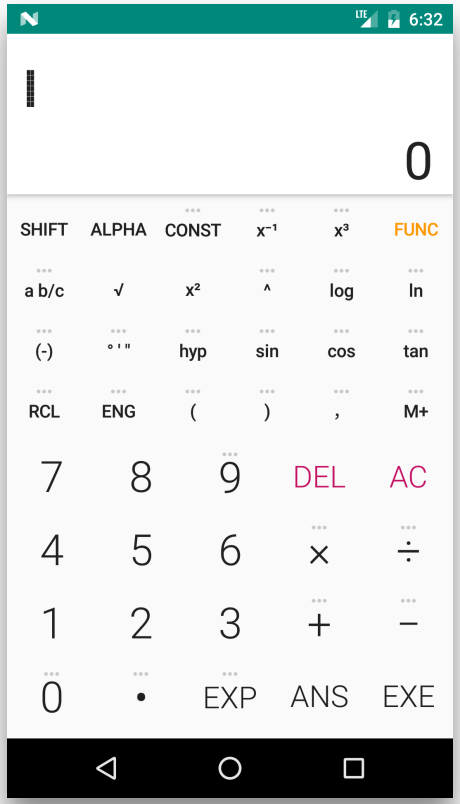


Casio Fx-50FH

Inspiration



Casio Fx-50FH

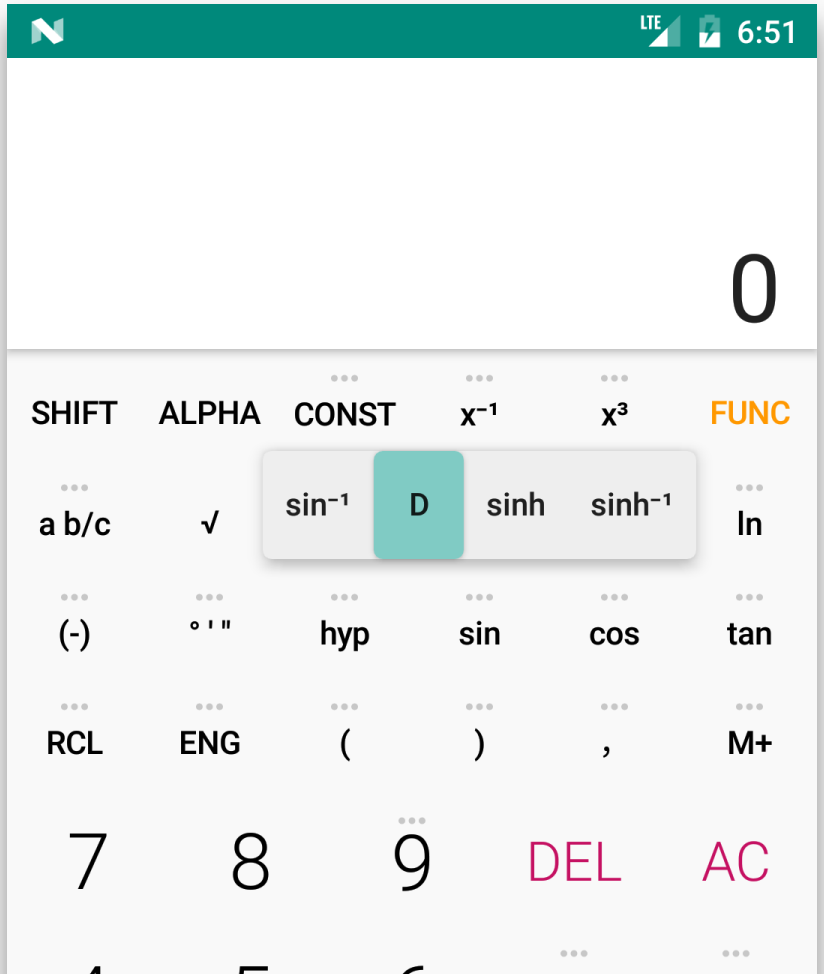


Procal

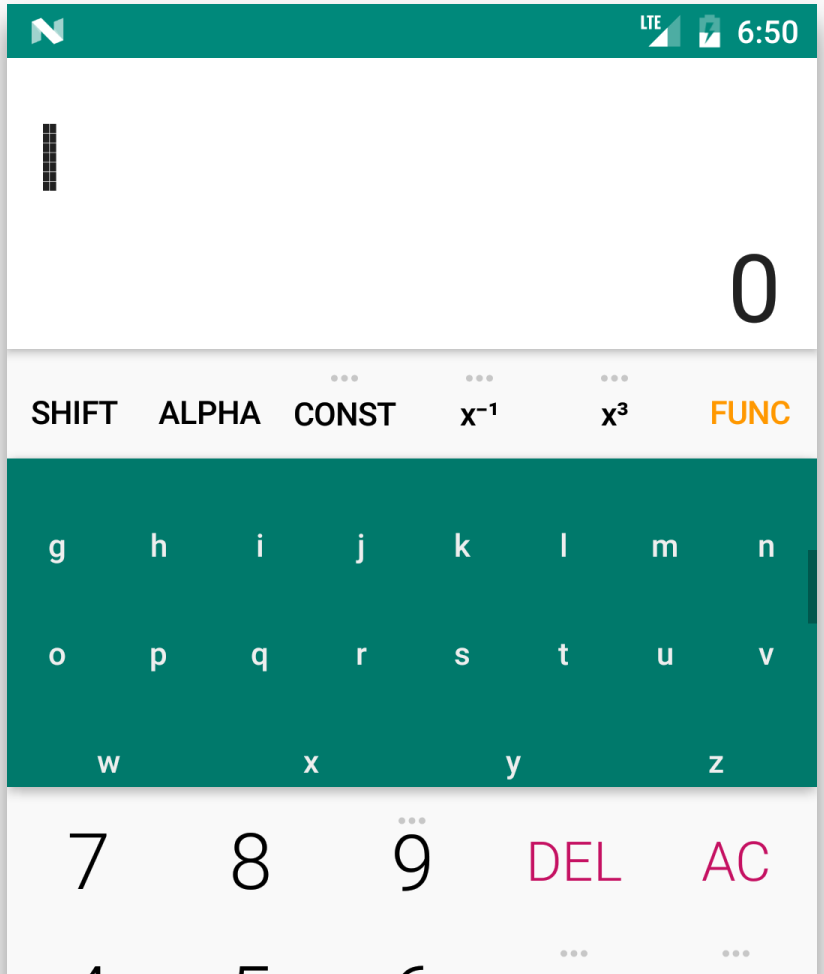
Flexible UI

Less button-pressing, more productivity

Popups



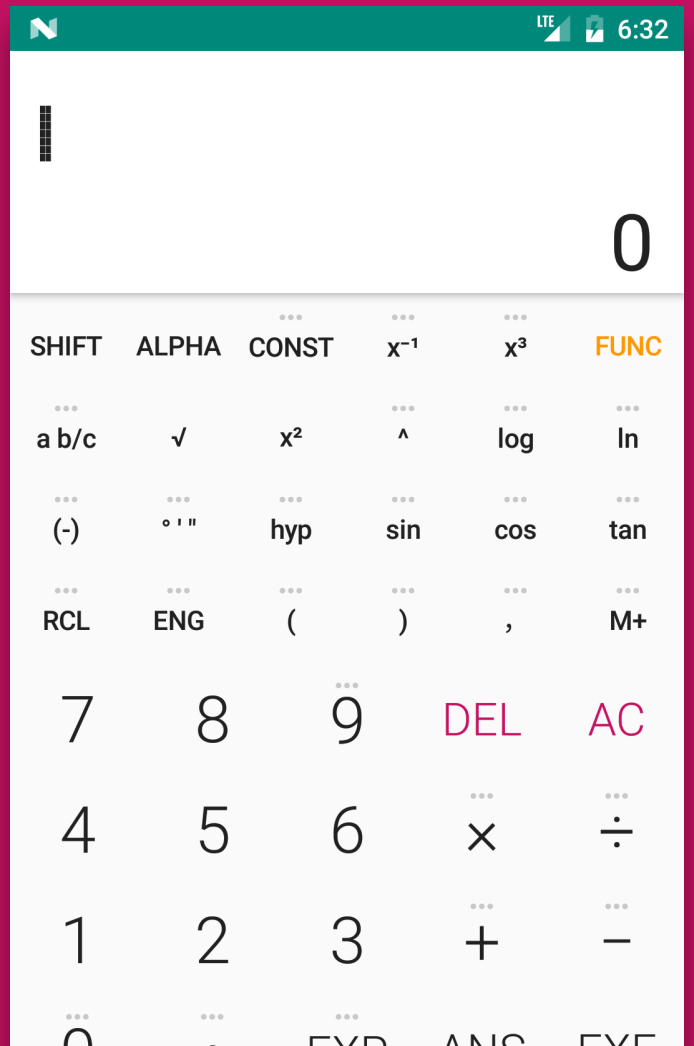
Scrollable Drawers



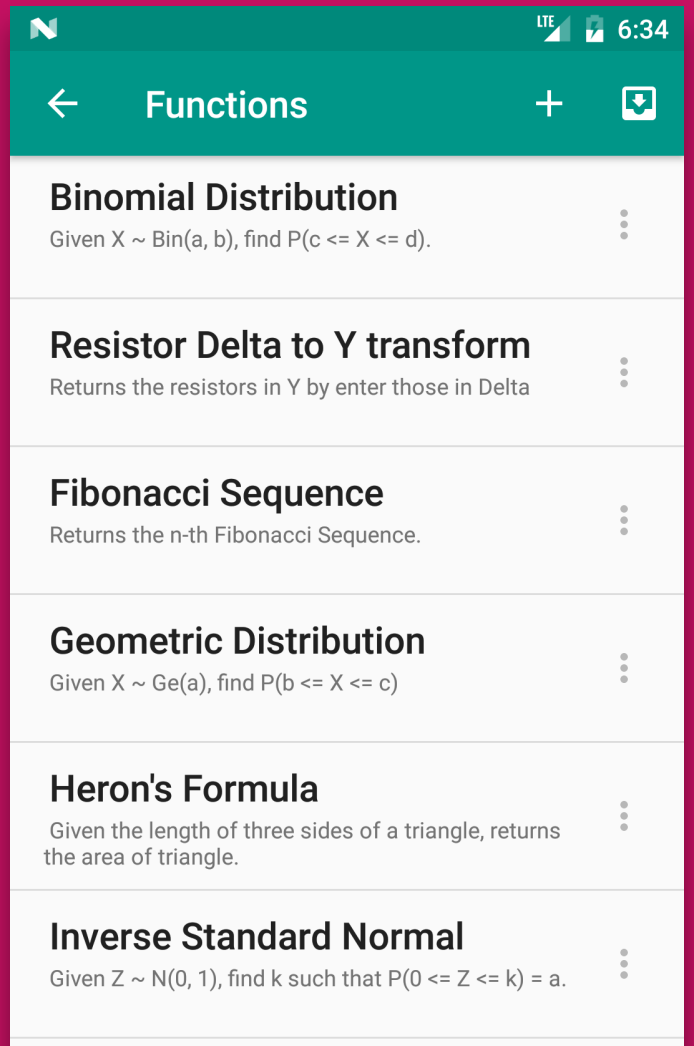
Variables Galore

Screens

Normal



Function Selection



Function Edit

Programmability

Functions

- 28 preset programs
- Unlimited user programs slots
- Desktop editable program files
- Familiar language syntax

A program opened with Notepad++

```
/**
 * Center, Radius and Equation of Circle from 3 given points
 * Consider three points (x1, y1), (x2, y2), (x3, y3)
 * and a circle with center (X, Y), radius R and equation x^2 + y^2 + Dx + Ey + F = 0
 * @param x1, y1, x2, y2, x3, y3
 * @return X, Y, R, D, E, F
 * @sampleIn 5, 2, 2, 3, 6, -5
 * @sampleOut 2, -2, 5, -4, 4, -17
 */
?->$A: ?->$B: ?->$X: ?->$Y:
($X-$A)/($B-$Y) -> $C:
0.5($B+$Y-$C($A+$X)) -> $D:
?->$X: ?->$Y:
($X-$A)/($B-$Y) -> $M:
0.5($B+$Y-$M($A+$X)) -> $Y:
($Y-$D)/($C-$M) -> $C display /* x coord of center */
$M$C + $Y -> $D display /* y coord of center */
sqrt(($A - $C)^2 + ($B - $D)^2) display /* radius */
-2 $C display /* coeff of x */
-2 $D display /* coeff of y */
$C^2 + $D^2 - (($A - $C)^2 + ($B - $D)^2) display /* constant term */
```

Major Syntax Improvements

- Nestable code blocks (if-statements, while-loops and for-loops)
- No expression input limit
- Variable names with more than 1 character and underscore, case sensitive
- …

Program Sharing & Import

Hey, do you know how to calculate Poisson Distribution?

Program Sharing & Import

Hey, do you know how to calculate Poisson Distribution?

Sure, you want a program?

Program Sharing & Import

Hey, do you know how to calculate Poisson Distribution?

Sure, you want a program?

Do you have one?

Program Sharing & Import

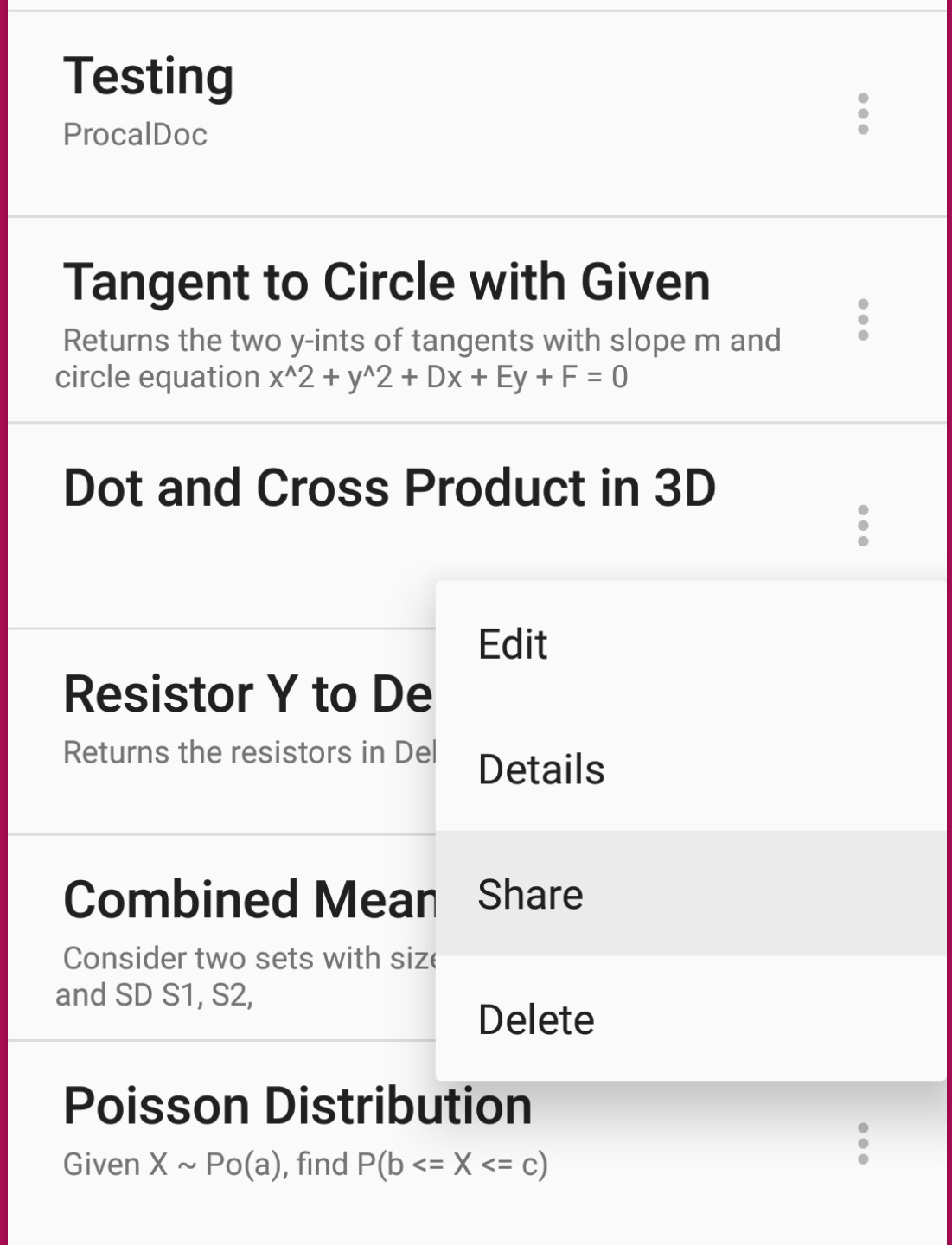
Hey, do you know how to calculate Poisson Distribution?

Sure, you want a program?

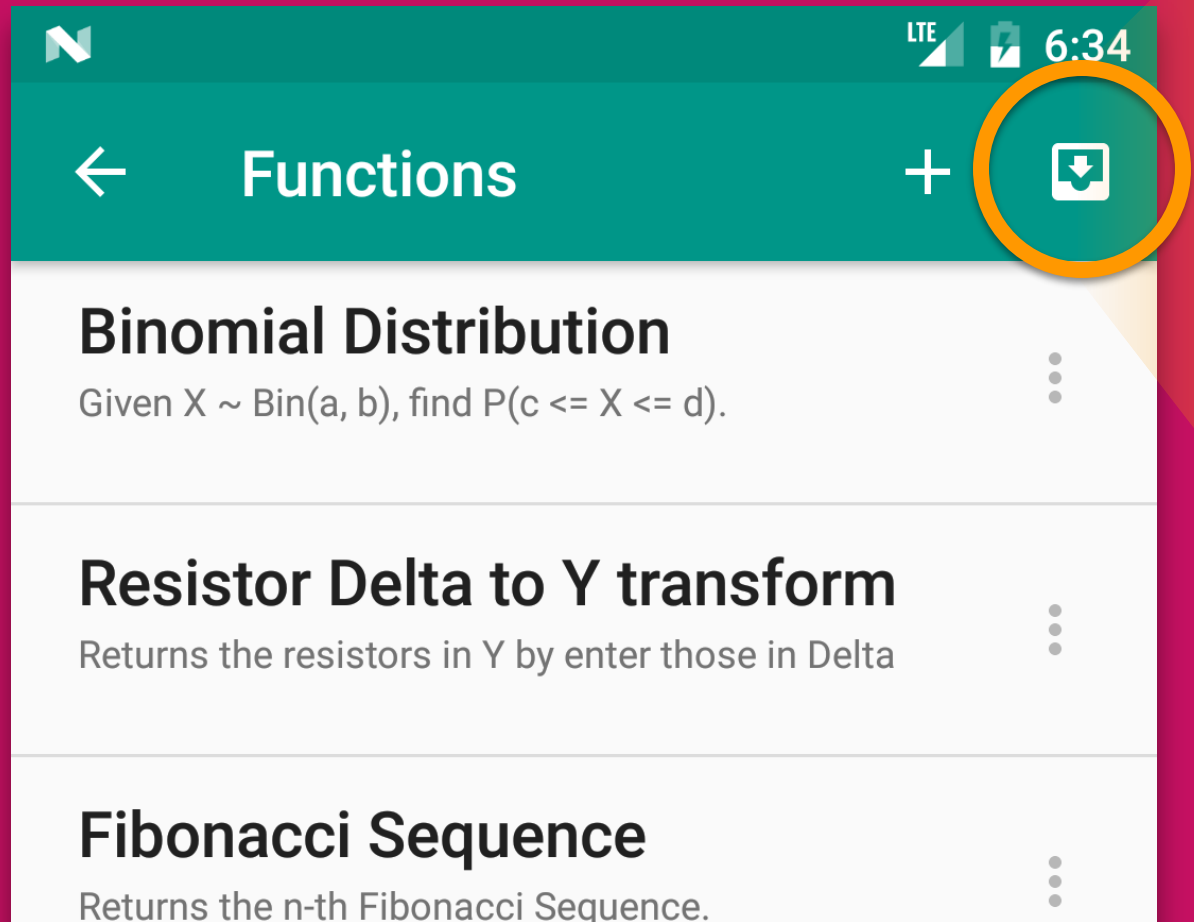
Do you have one?

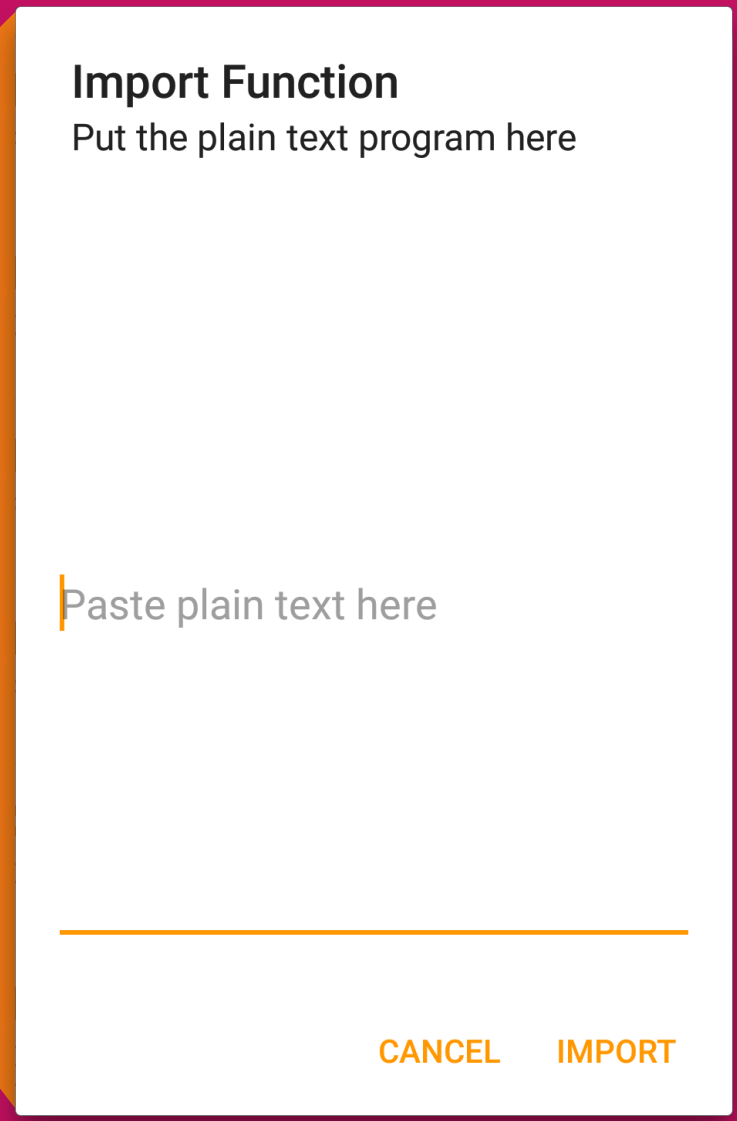
```
/**
 * Poisson Distribution
 * Given X ~ Po(a), find P(b <= X <= c)
 * @param a, b, c
 * @return P(b <= X <= c)
 * @sampleIn 4, 3, 7
 * @sampleOut 0.7108
 * @sampleIn 4, 3, 3
 * @sampleOut 0.1954
 */
?->$A: ?->$B: $B->$C: ?->$C: 0->$M:
For $B -> $B To $C:
    $M + $A^$B / ($B factorial * &exp^($A)) -> $M
Next:
$M
```

Share from Procal



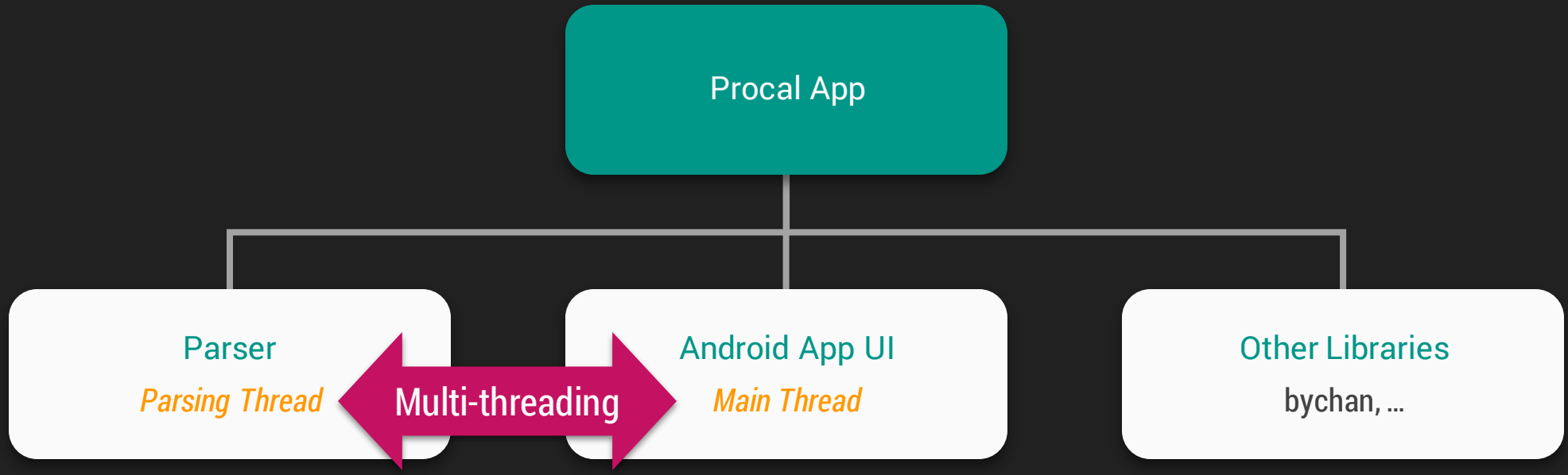
Import Plain String



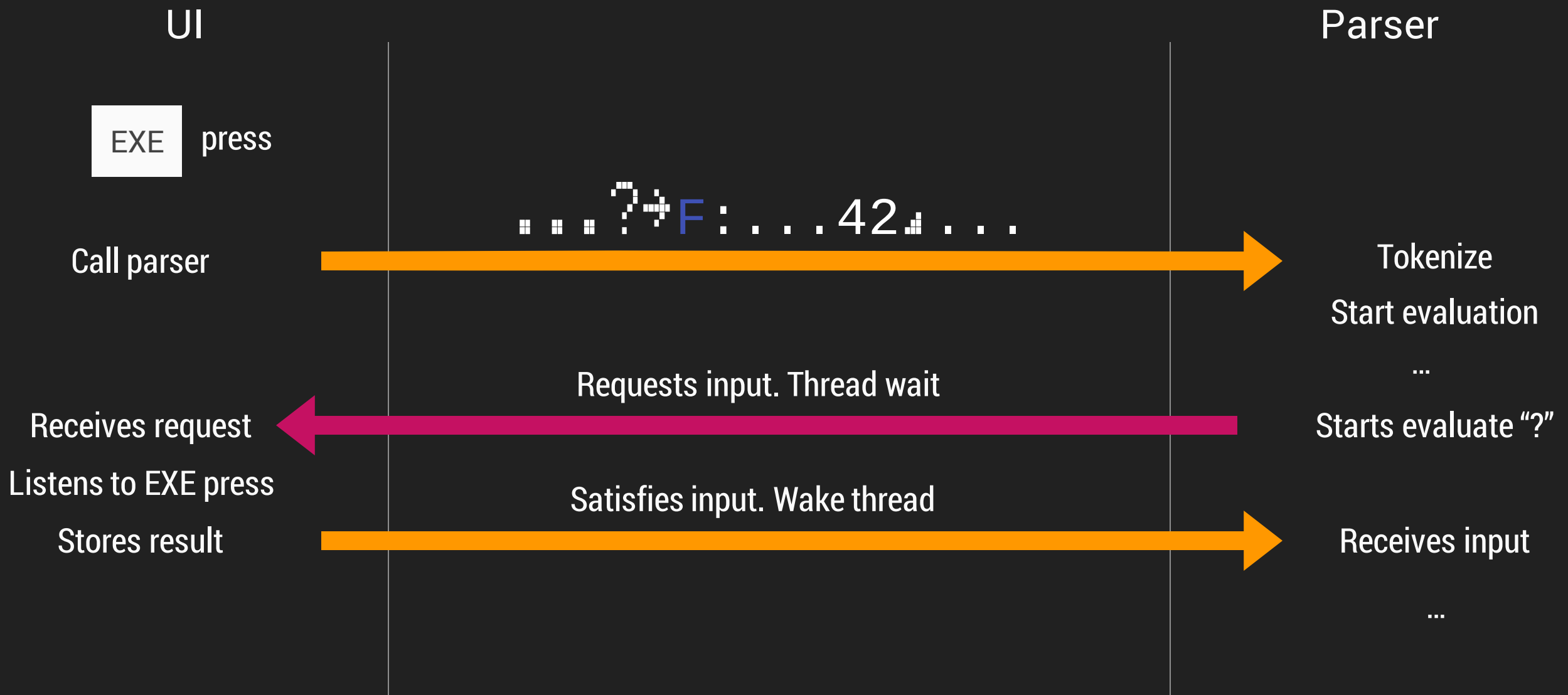


Implementation

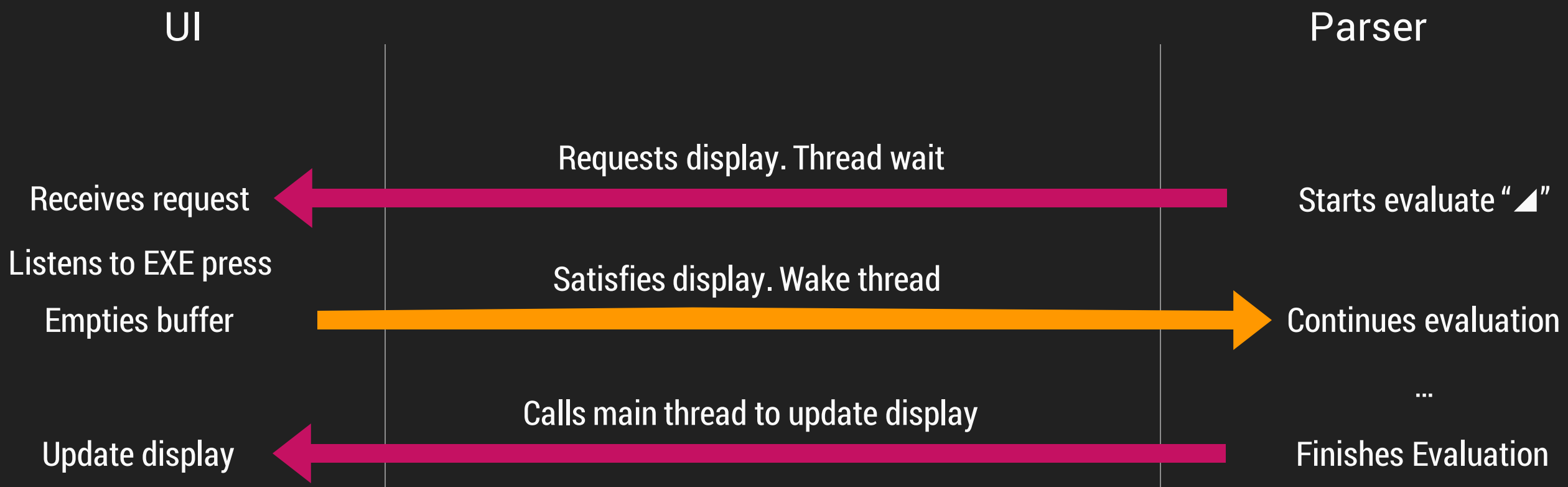
Modulation


Procal App
Parser
Parsing Thread
Multi-threading
Android App UI
Main Thread
Other Libraries
bychan, ...

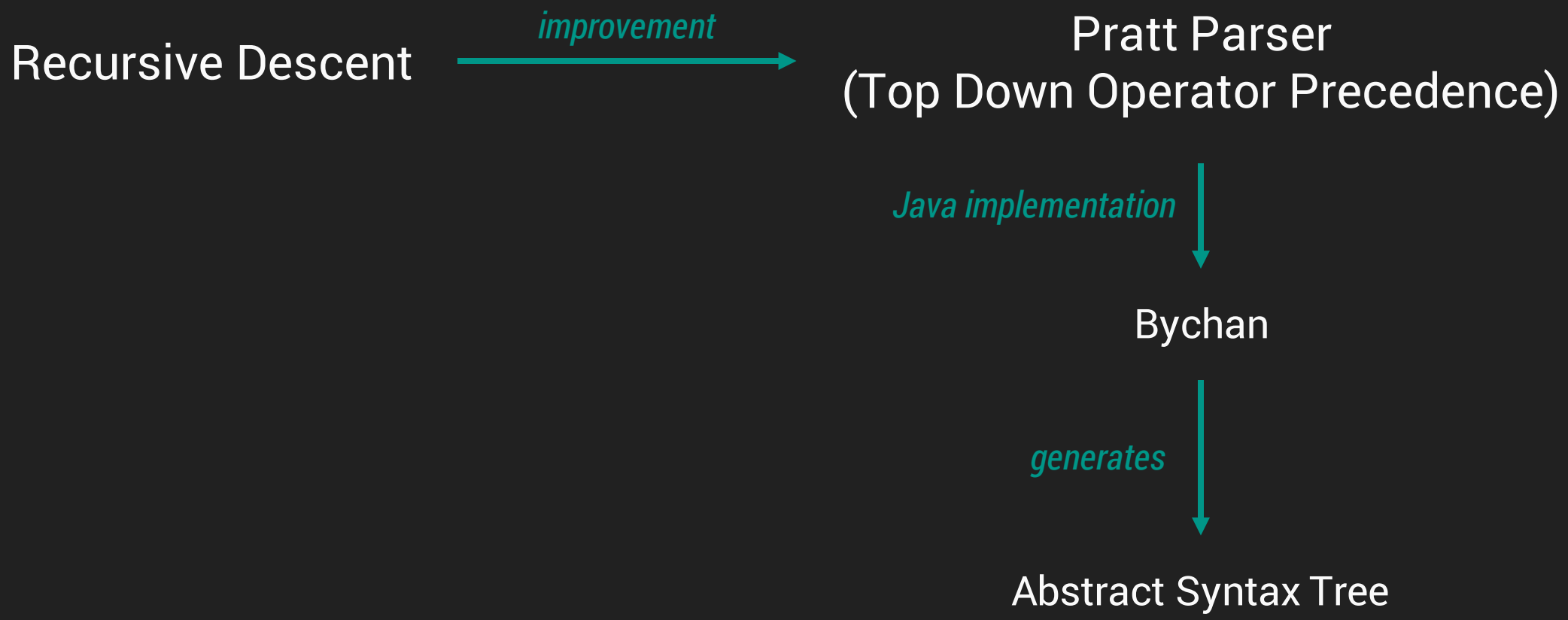
Modulation


UI
Parser
EXE
press
...?→F:...42...
Call parser
Tokenize
Start evaluation
...
Requests input. Thread wait
Receives request
Starts evaluate "?"
Listens to EXE press
Satisfies input. Wake thread
Stores result
Receives input
...

Modulation


UI
Parser
Requests display. Thread wait
Receives request
Starts evaluate "◢"
Listens to EXE press
Satisfies display. Wake thread
Empties buffer
Continues evaluation
...
Calls main thread to update display
Update display
Finishes Evaluation

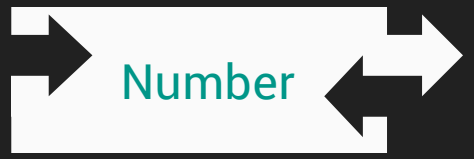
Parser


Recursive Descent
improvement
Pratt Parser
(Top Down Operator Precedence)
Java implementation
Bychan
generates
Abstract Syntax Tree

Pratt Parser (LED and NUD analogy)

Null denoted

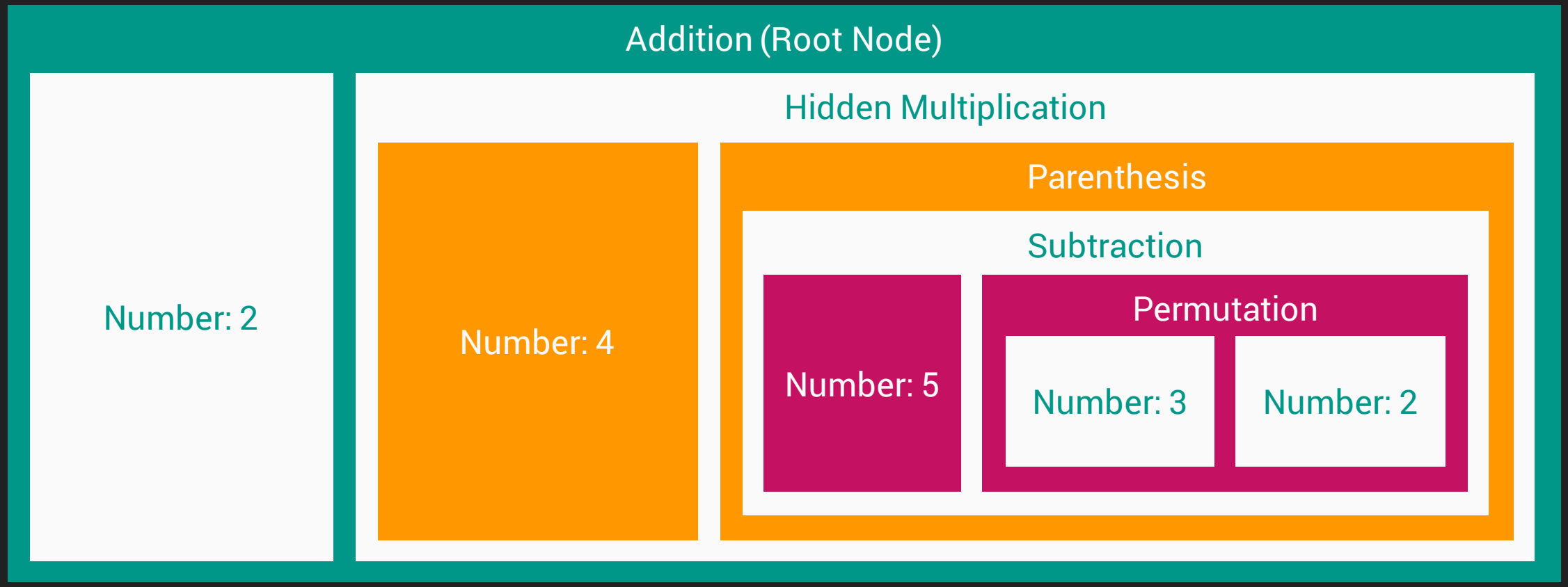
Left denoted



Pratt Parser (Abstract Syntax Tree Example)

Pratt Parser (Abstract Syntax Tree Example)

```
2+4(5-3P2)
```



Pratt Parser (Abstract Syntax Tree Example)

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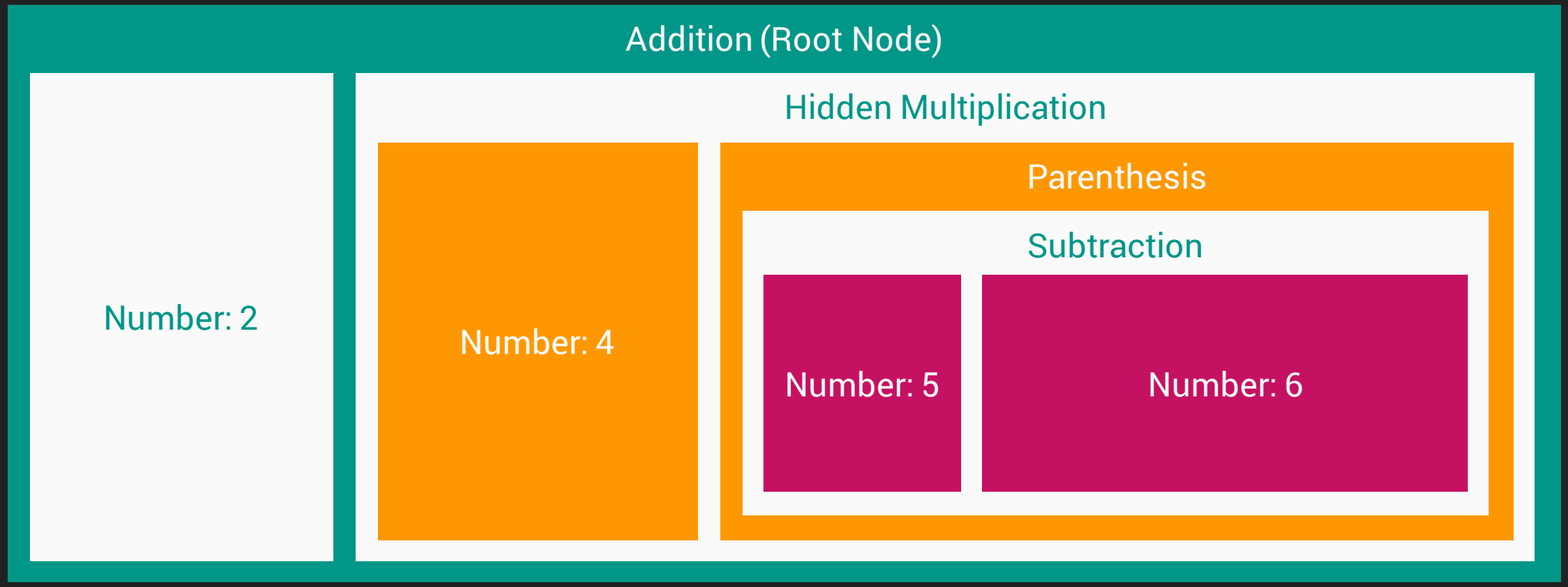
2+4(5-3P2)
```



Pratt Parser (Abstract Syntax Tree Example)

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```

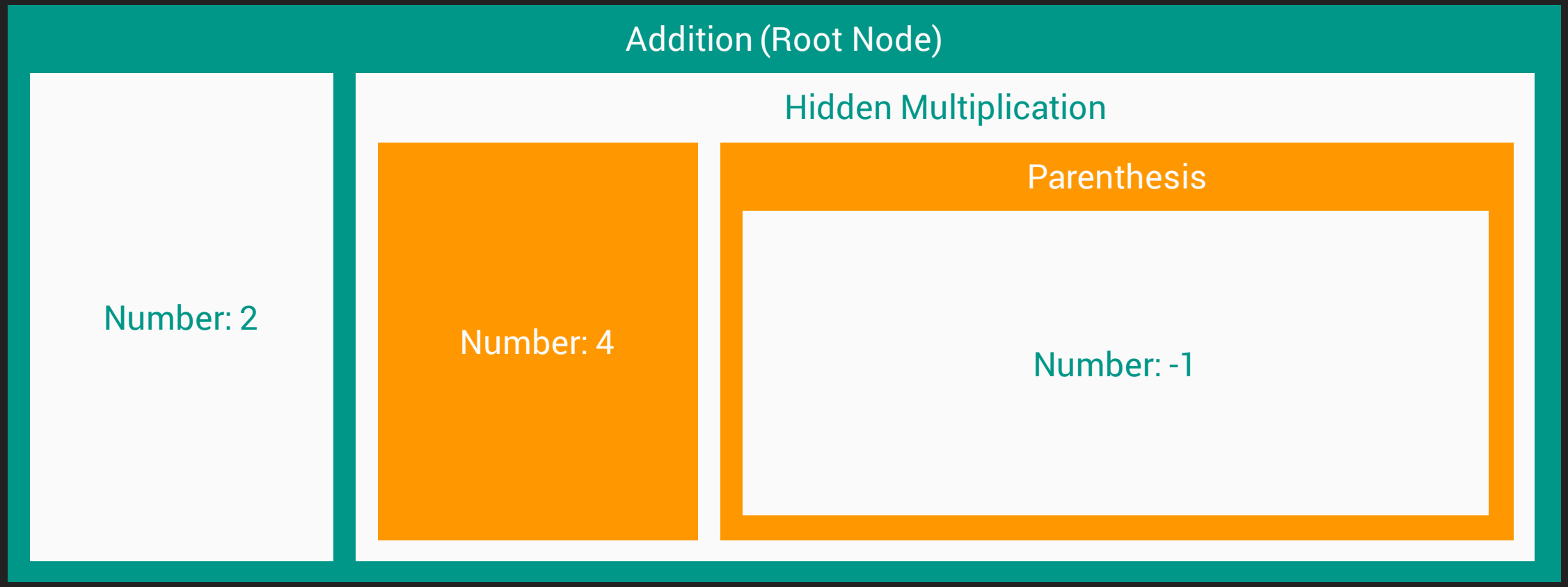

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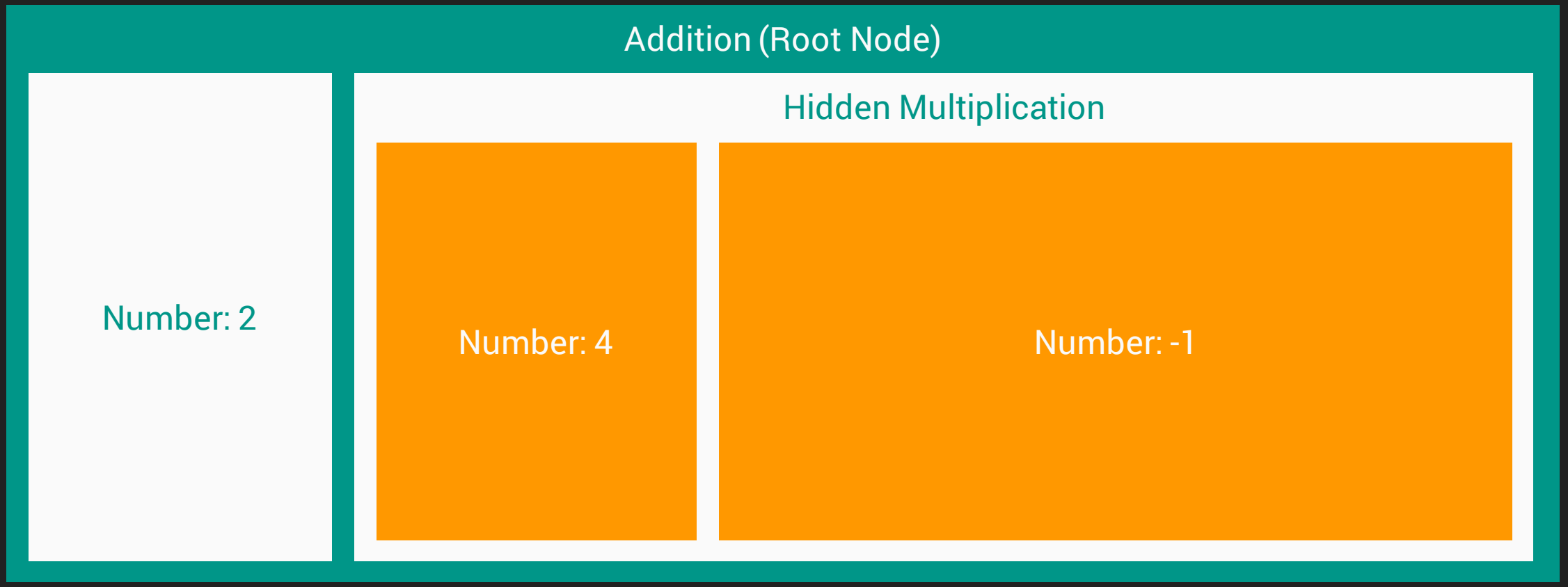

Pratt Parser (Abstract Syntax Tree Example)

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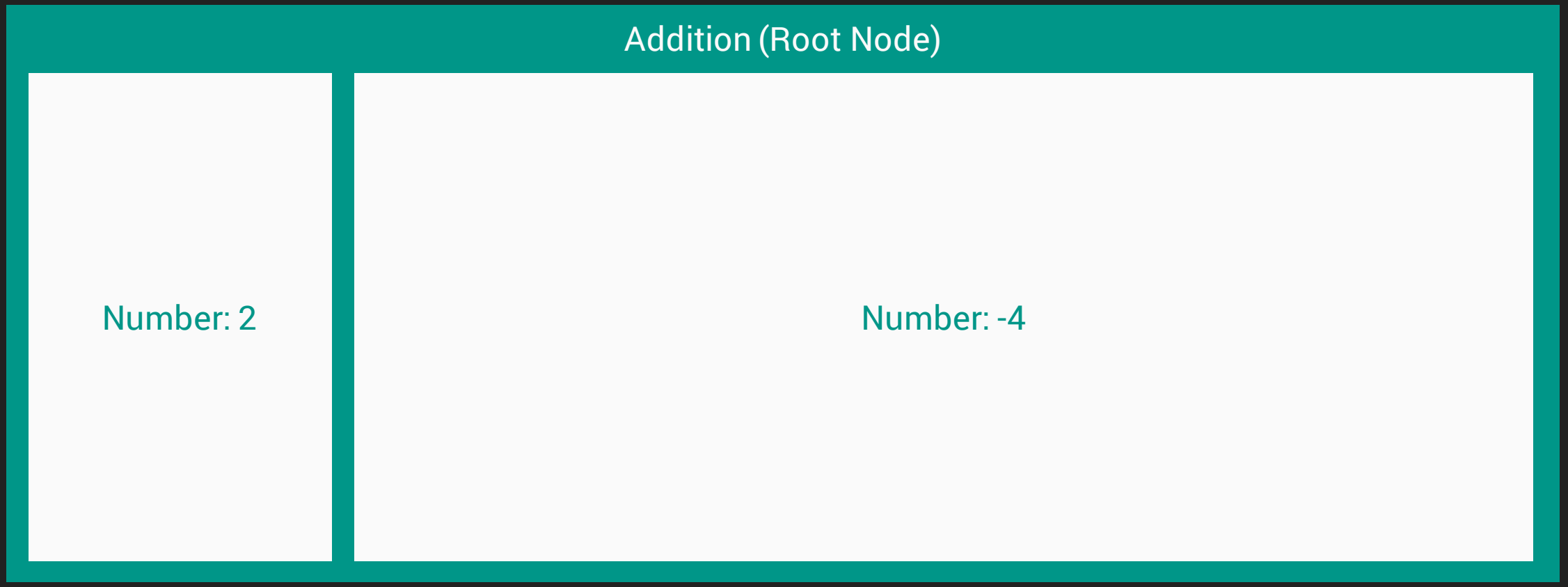


Pratt Parser (Abstract Syntax Tree Example)

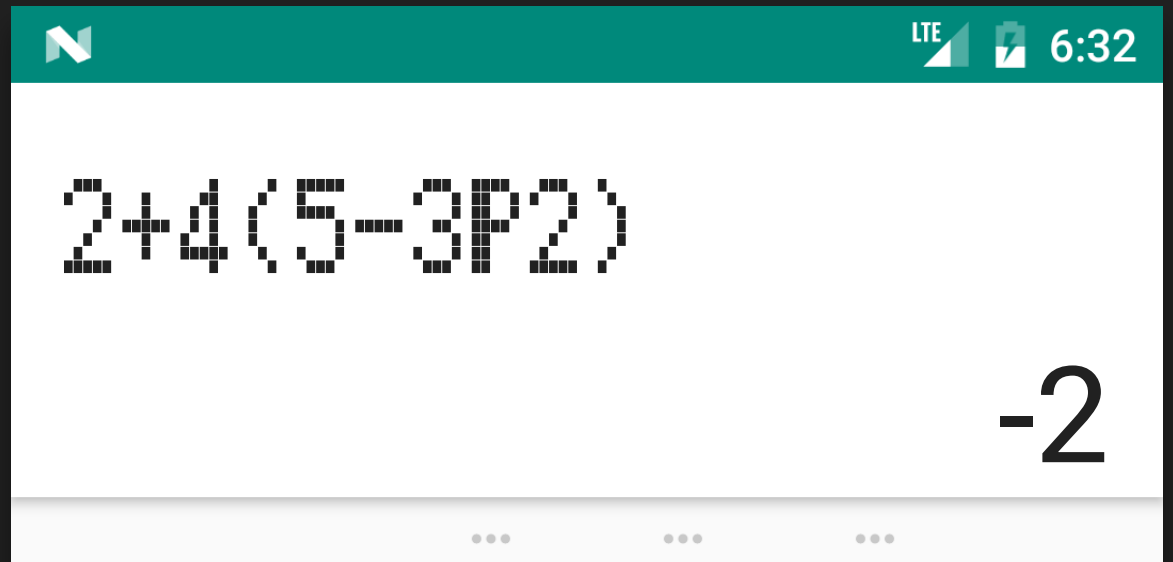
```
2+4(5-3P2)
```

Number: -2

Pratt Parser (Abstract Syntax Tree Example)

2+4(5-3P2)

Number: -2



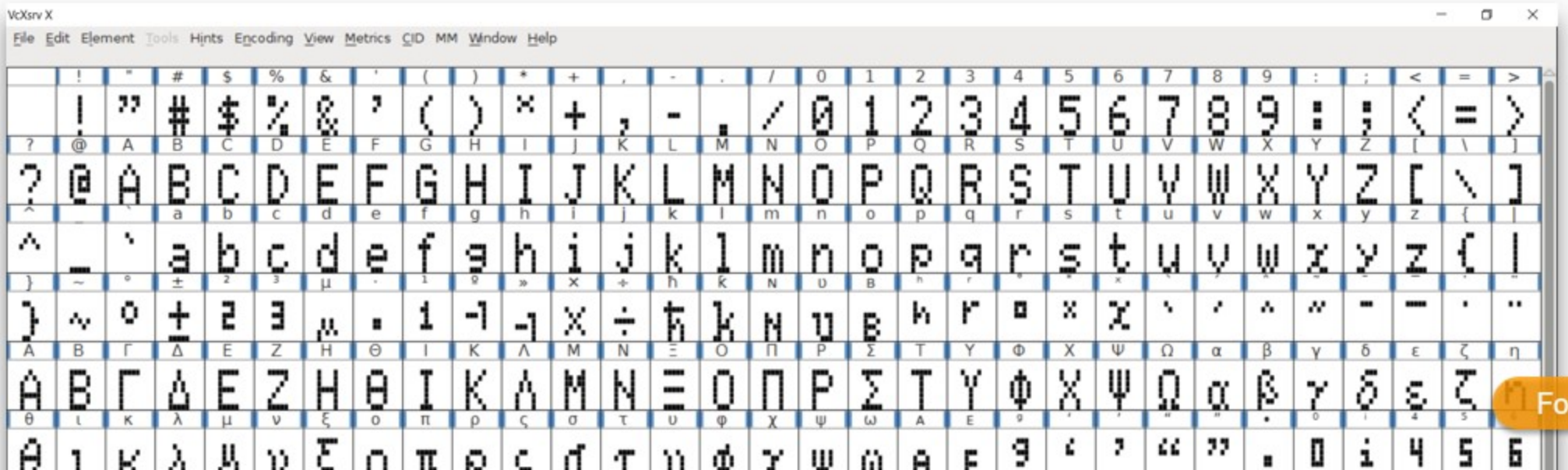
Pratt Parser (Drawbacks)

- Difficult to implement Goto and Label nodes under AST

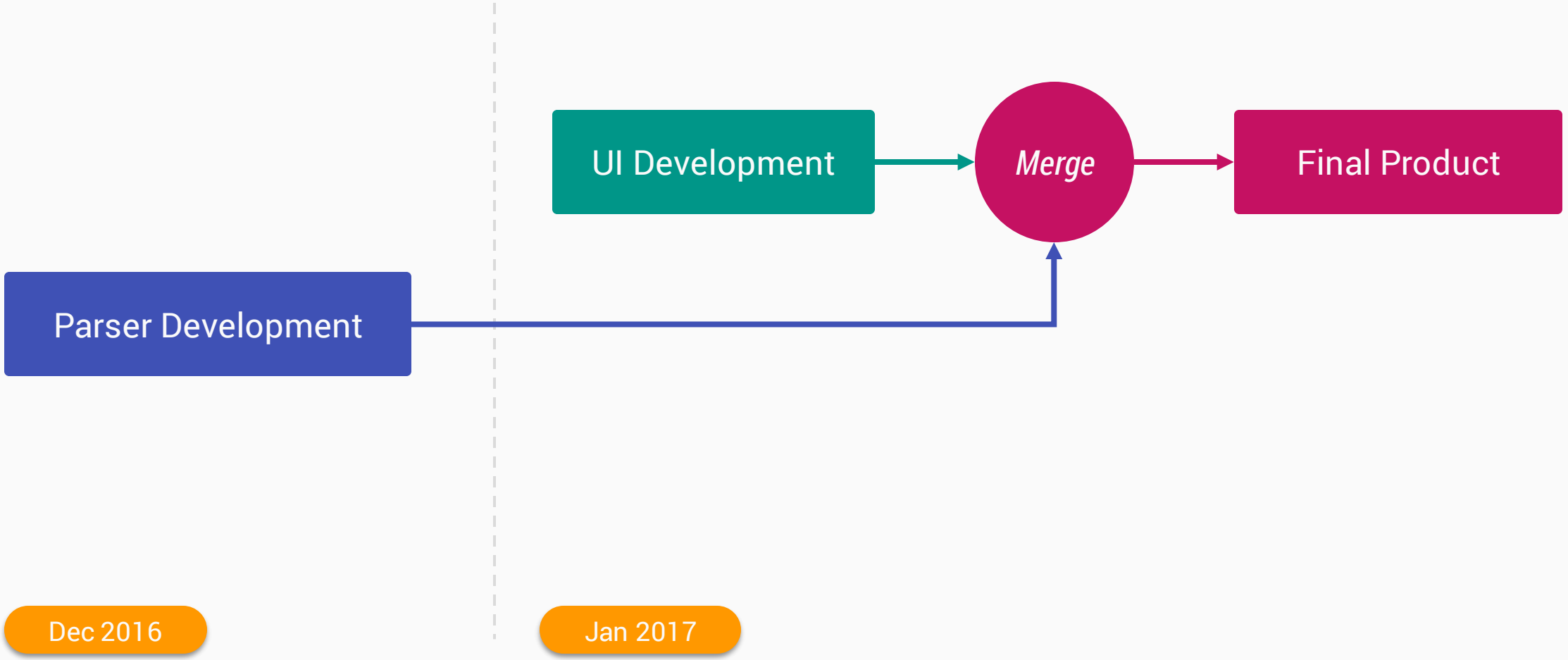
Custom Display Font

The quick brown fox jumps over the lazy dog.

Λορεμ ιπσθμ δολορ σιτ αμετ, ναϑ νε ωισι αφφερτ λιβρισ.



Time Management



Evaluations

Future Improvements

- Lower supported Android API level.

  >70% of devices will be supported if API level is lowered to at least KitKat (API 19)

- Polish UI and UX

  Improves ease of use and user-friendliness

- Implement more calculator features

  Different angle units, complex numbers, base operation, etc.

Thank you!

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