

# Procal

Programmable Scientific Calculator for Android L+

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Programmability

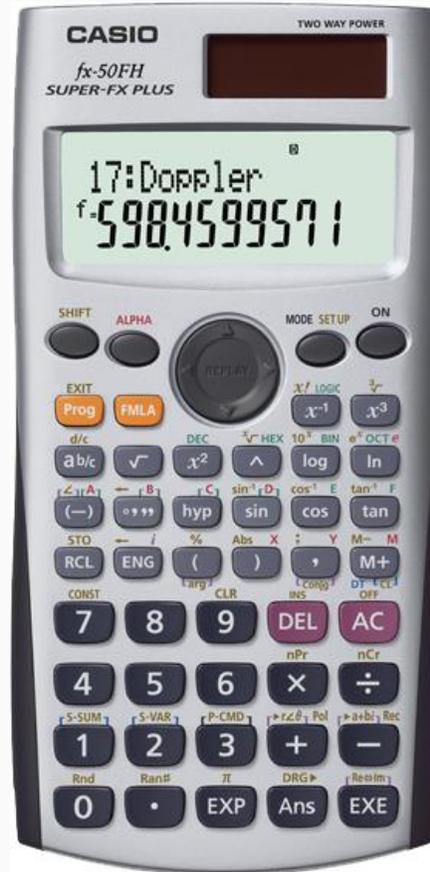
Flexible UI

*Core Aims*

Easy Transition

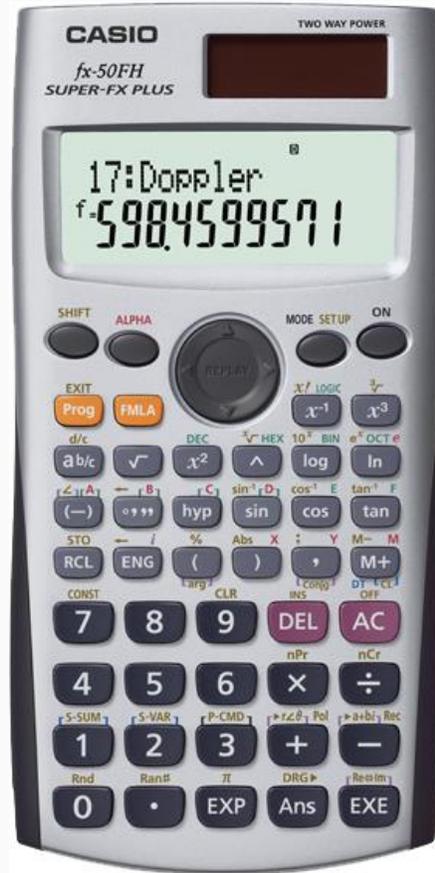
Easy Transition

# Inspiration

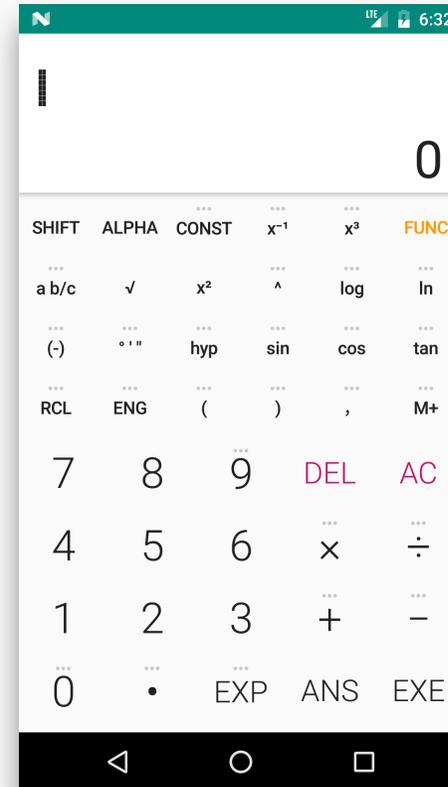


Casio Fx-50FH

# Inspiration



Casio Fx-50FH

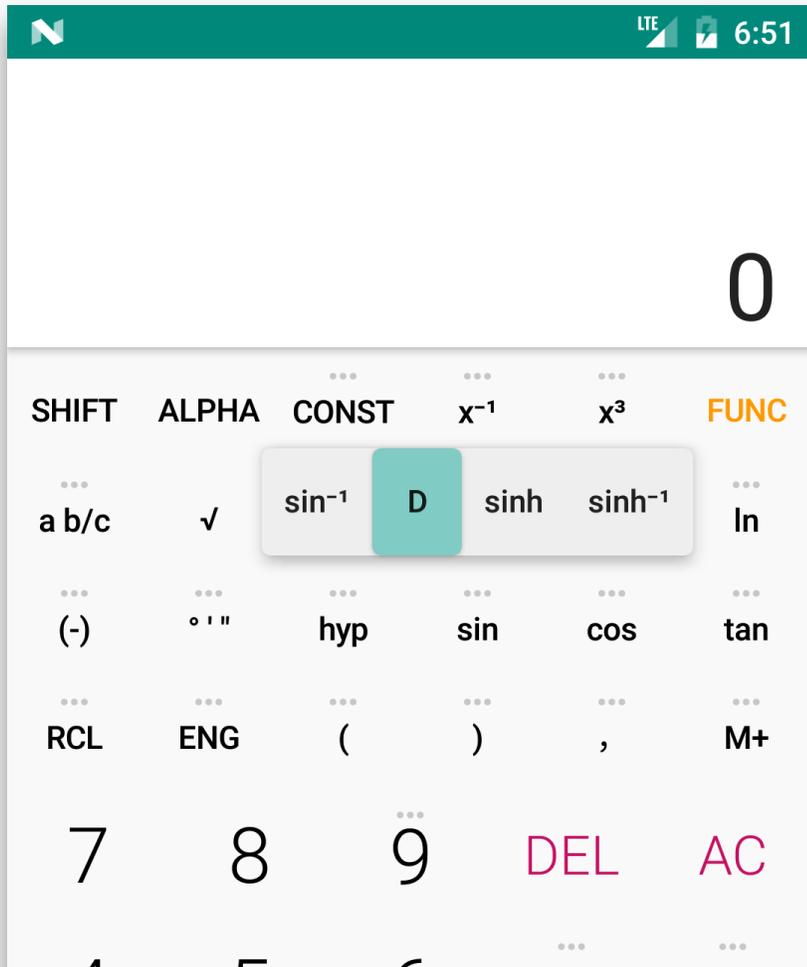


Procal

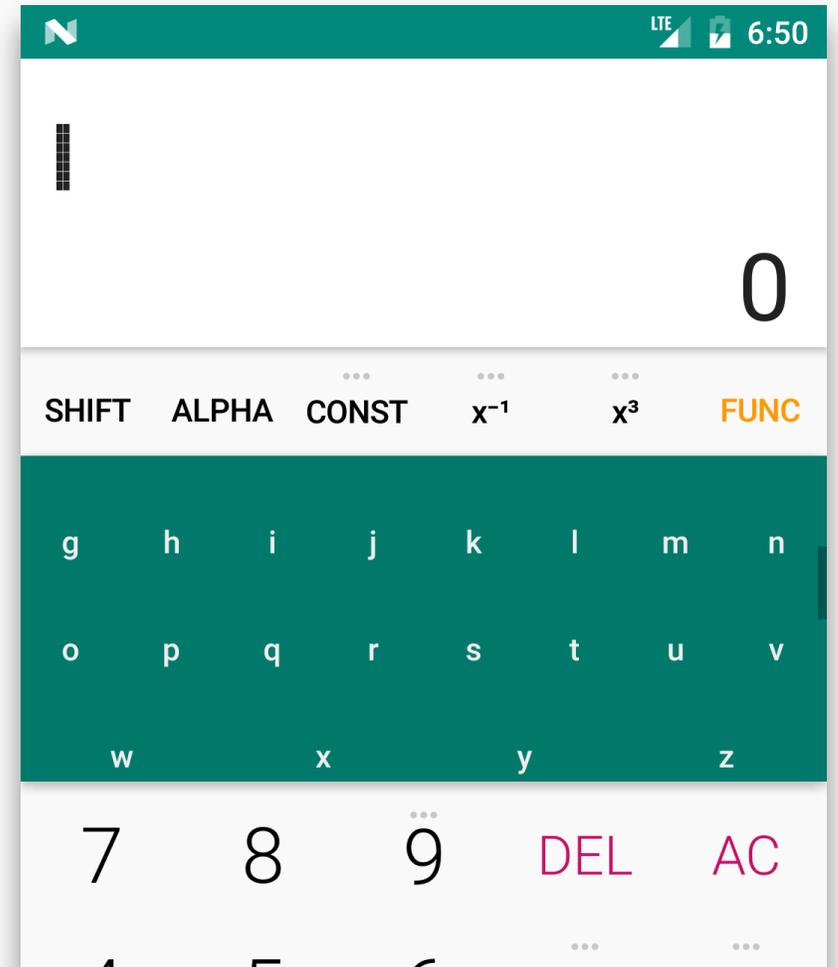
# Flexible UI

# Less button-pressing, more productivity

Popups



Scrollable Drawers



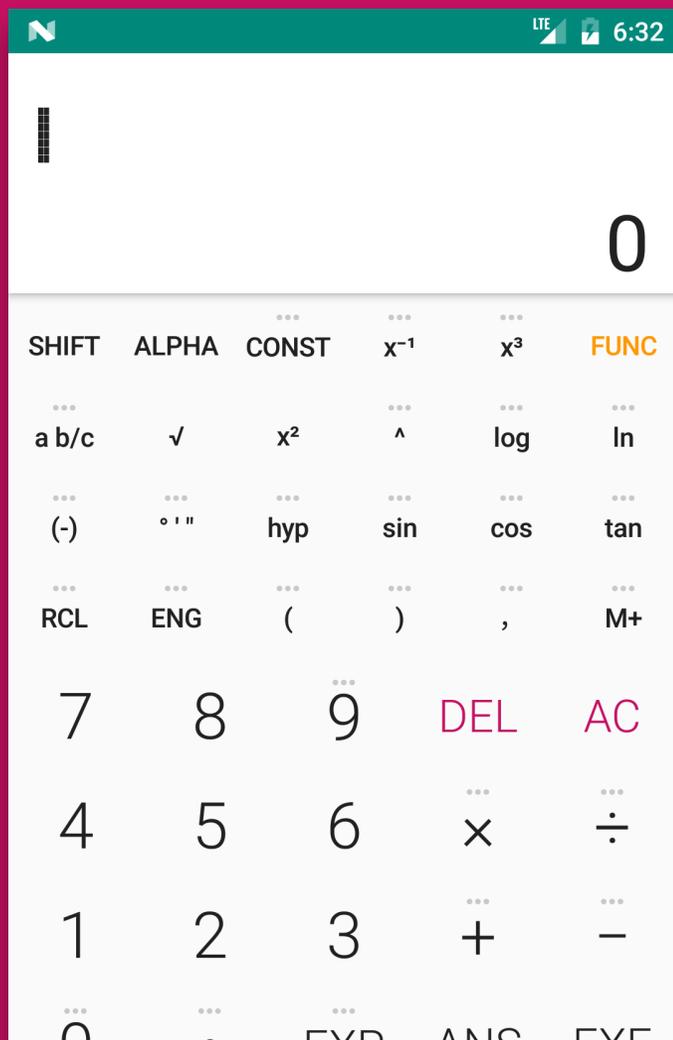
# Variables Galore

ABCDEFGHIJKLMNOPQRSTUVWXYZ  
abcdefghijklmnopqrstuvwxyz  
ΑΒΓΔΕΖΗΘΙΚΛΜΝΞΟΠΡΣΤΥΦΧΨΩ  
αβγδεζηθικλμνξοπρστυφχψω



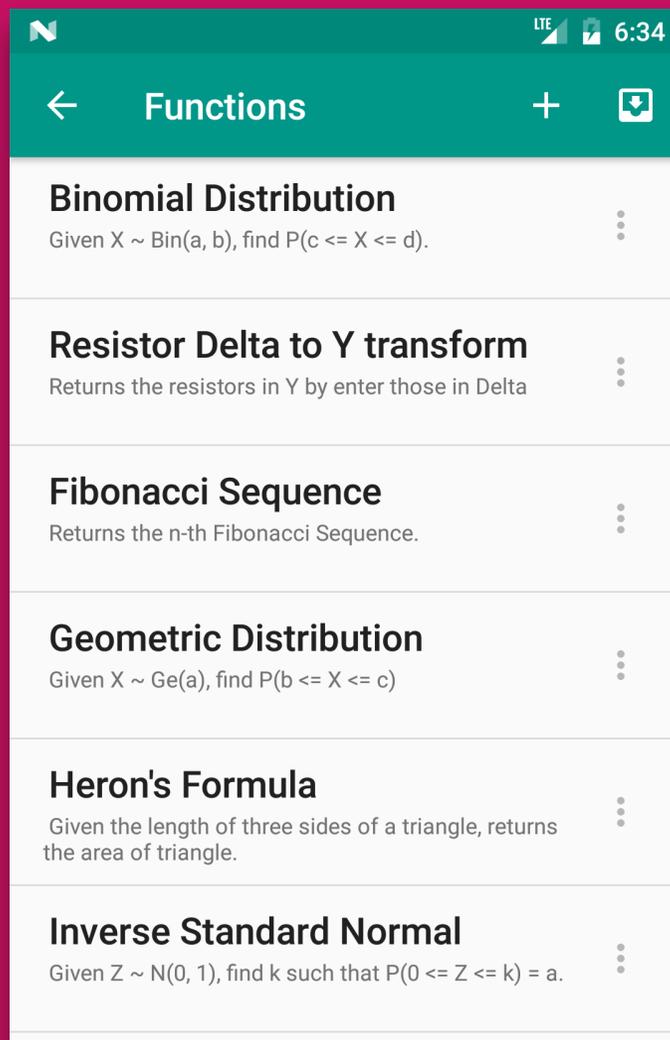
# Screens

Normal



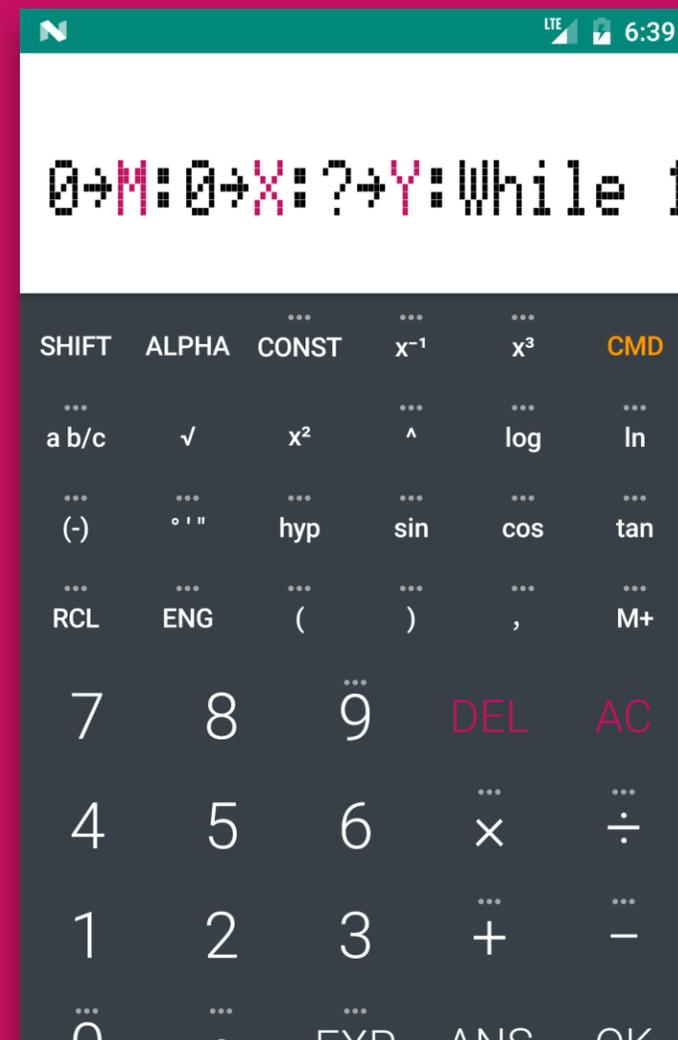
The Normal calculator screen shows a display with the number 0. Below the display is a grid of function keys: SHIFT, ALPHA, CONST,  $x^{-1}$ ,  $x^3$ , and FUNC. The next row contains a/c,  $\sqrt{\quad}$ ,  $x^2$ ,  $\wedge$ , log, and ln. The third row has (-),  $\circ \cdot \cdot$ , hyp, sin, cos, and tan. The fourth row includes RCL, ENG, (, ), ,, and M+. Below these are rows of numeric keys: 7, 8, 9, DEL, AC; 4, 5, 6,  $\times$ ,  $\div$ ; 1, 2, 3, +, -; and 0,  $\frac{\square}{\square}$ , EXP, ANS, FIVE.

Function Selection



The Function Selection screen is titled "Functions" and lists several statistical and mathematical functions. Each function has a title, a brief description, and a menu icon (three dots). The functions listed are: Binomial Distribution (Given  $X \sim \text{Bin}(a, b)$ , find  $P(c \leq X \leq d)$ ); Resistor Delta to Y transform (Returns the resistors in Y by enter those in Delta); Fibonacci Sequence (Returns the n-th Fibonacci Sequence.); Geometric Distribution (Given  $X \sim \text{Ge}(a)$ , find  $P(b \leq X \leq c)$ ); Heron's Formula (Given the length of three sides of a triangle, returns the area of triangle.); and Inverse Standard Normal (Given  $Z \sim N(0, 1)$ , find k such that  $P(0 \leq Z \leq k) = a$ ).

Function Edit



The Function Edit screen shows a text input field with the expression  $0 \rightarrow M : 0 \rightarrow X : ? \rightarrow Y : \text{While } 1$ . Below the input field is a grid of function keys: SHIFT, ALPHA, CONST,  $x^{-1}$ ,  $x^3$ , and CMD. The next row contains a/c,  $\sqrt{\quad}$ ,  $x^2$ ,  $\wedge$ , log, and ln. The third row has (-),  $\circ \cdot \cdot$ , hyp, sin, cos, and tan. The fourth row includes RCL, ENG, (, ), ,, and M+. Below these are rows of numeric keys: 7, 8, 9, DEL, AC; 4, 5, 6,  $\times$ ,  $\div$ ; 1, 2, 3, +, -; and 0,  $\frac{\square}{\square}$ , EXP, ANS, OK.

Programmability

# Functions

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

A program opened with Notepad++

```
1  /**
2   * Center, Radius and Equation of Circle from 3 given points
3   * Consider three points (x1, y1), (x2, y2), (x3, y3)
4   * and a circle with center (X, Y), radius R and equation x^2 + y^2 + Dx + Ey + F = 0
5   * @param x1, y1, x2, y2, x3, y3
6   * @return X, Y, R, D, E, F
7   * @sampleIn 5, 2, 2, 3, 6, -5
8   * @sampleOut 2, -2, 5, -4, 4, -17
9   */
10  ?->$A: ?->$B: ?->$X: ?->$Y:
11  ($X-$A)/($B-$Y) -> $C:
12  0.5($B+$Y-$C($A+$X)) -> $D:
13  ?->$X: ?->$Y:
14  ($X-$A)/($B-$Y) -> $M:
15  0.5($B+$Y-$M($A+$X)) -> $Y:
16  ($Y-$D)/($C-$M) -> $C display /* x coord of center */
17  $M$C + $Y -> $D display /* y coord of center */
18  sqrt((($A - $C)^2 + ($B - $D)^2) display /* radius */
19  -2 $C display /* coeff of x */
20  -2 $D display /* coeff of y */
21  $C^2 + $D^2 - ((($A - $C)^2 + ($B - $D)^2) display /* constant term */
22
```

# 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  $X \sim \text{Po}(a)$ , find  $P(b \leq X \leq c)$   
 * @param a, b, c  
 * @return  $P(b \leq X \leq c)$   
 * @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

## Testing

ProcalDoc



## Tangent to Circle with Given

Returns the two y-ints of tangents with slope  $m$  and circle equation  $x^2 + y^2 + Dx + Ey + F = 0$



## Dot and Cross Product in 3D



## Resistor Y to De

Returns the resistors in Del

Edit

Details

## Combined Mean

Consider two sets with size  
and SD  $S_1, S_2,$

Share

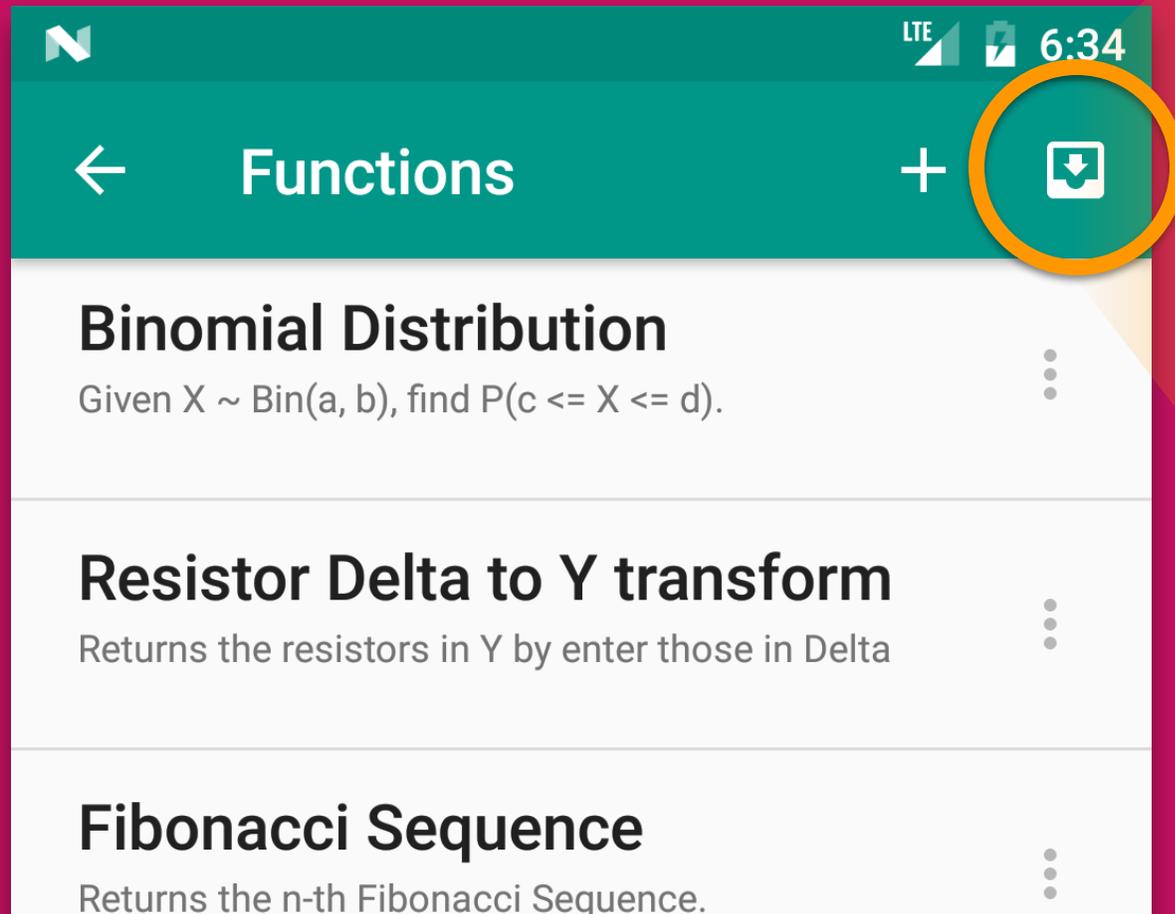
Delete

## Poisson Distribution

Given  $X \sim \text{Po}(a)$ , find  $P(b \leq X \leq c)$



# Import Plain String



## Import Function

Put the plain text program here

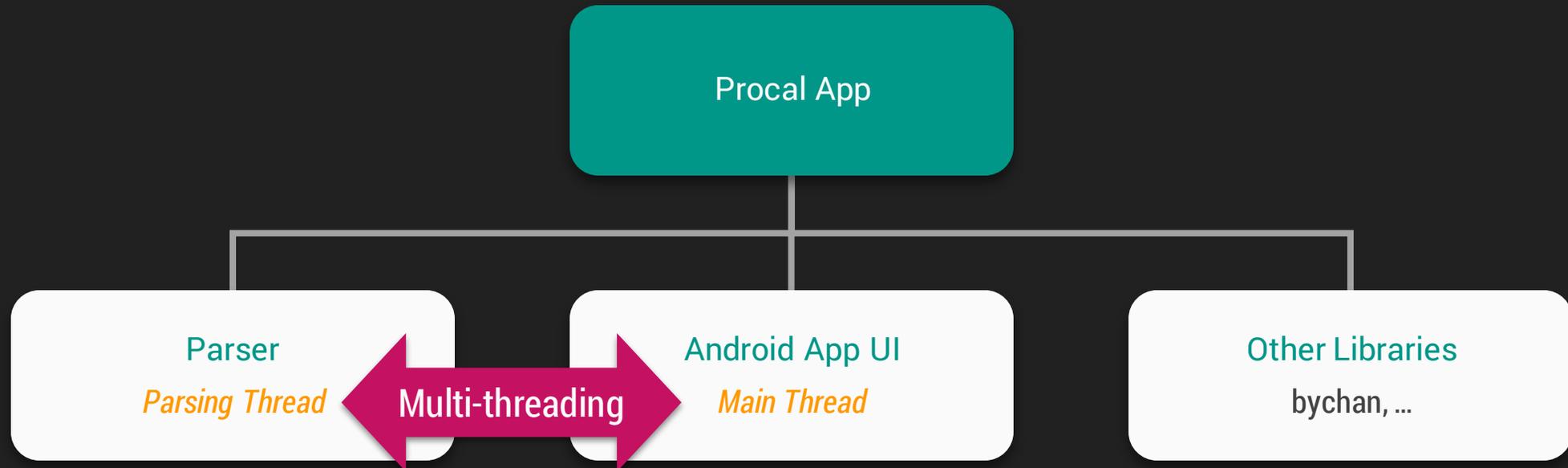
Paste plain text here

CANCEL IMPORT



Implementation

# Modulation



# 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



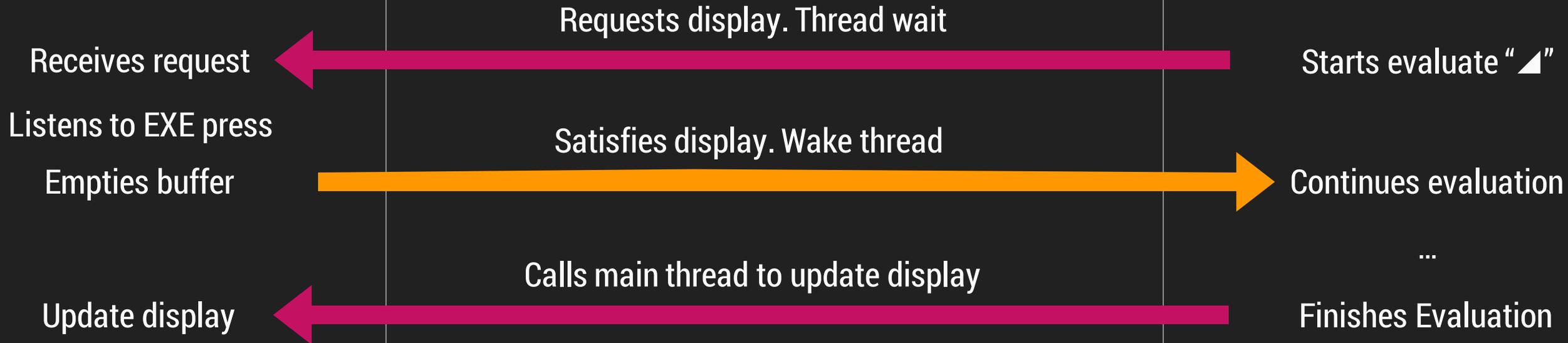
Receives input

...

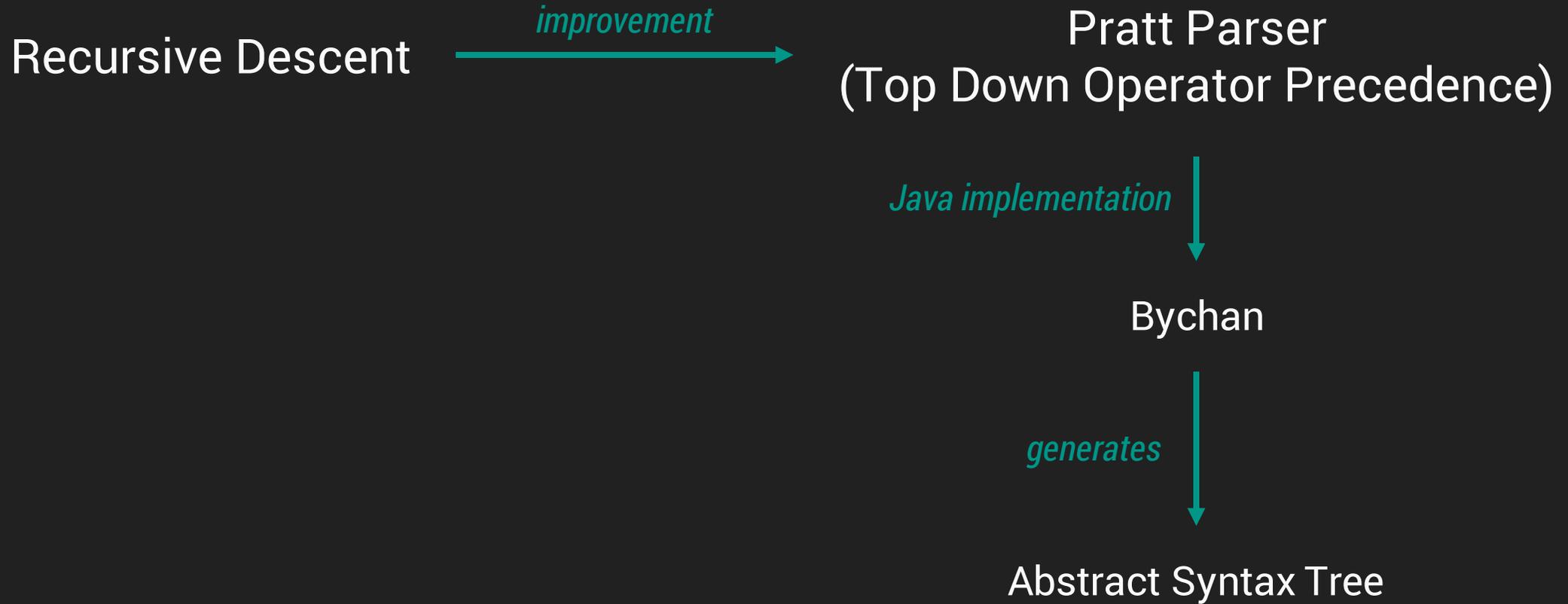
# Modulation

UI

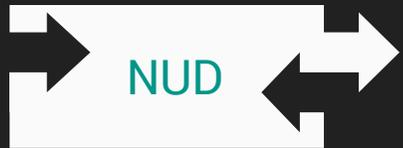
Parser



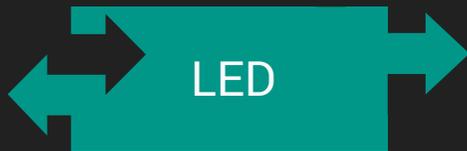
# Parser



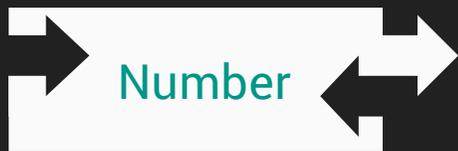
# Pratt Parser (LED and NUD analogy)



Null denoted



Left denoted





# Pratt Parser (Abstract Syntax Tree Example)

2+4(5-3\*2)

# Pratt Parser (Abstract Syntax Tree Example)

2+4(5-3\*2)

Addition (Root Node)

Number: 2

Number: 4

Hidden Multiplication

Parenthesis

Subtraction

Number: 5

Number: 3

Number: 2

Permutation

# Pratt Parser (Abstract Syntax Tree Example)

2+4(5-3)2

Addition (Root Node)

Number: 2

Number: 4

Number: 5

Number: 6

Hidden Multiplication

Parenthesis

Subtraction

# Pratt Parser (Abstract Syntax Tree Example)

2+4(5-3P2)

Addition (Root Node)

Number: 2

Number: 4

Hidden Multiplication

Parenthesis

Number: -1

# Pratt Parser (Abstract Syntax Tree Example)

2+4(5-3\*2)

Addition (Root Node)

Number: 2

Hidden Multiplication

Number: 4

Number: -1

# Pratt Parser (Abstract Syntax Tree Example)

2+4(5-3P2)

Addition (Root Node)

Number: 2

Number: -4

# Pratt Parser (Abstract Syntax Tree Example)

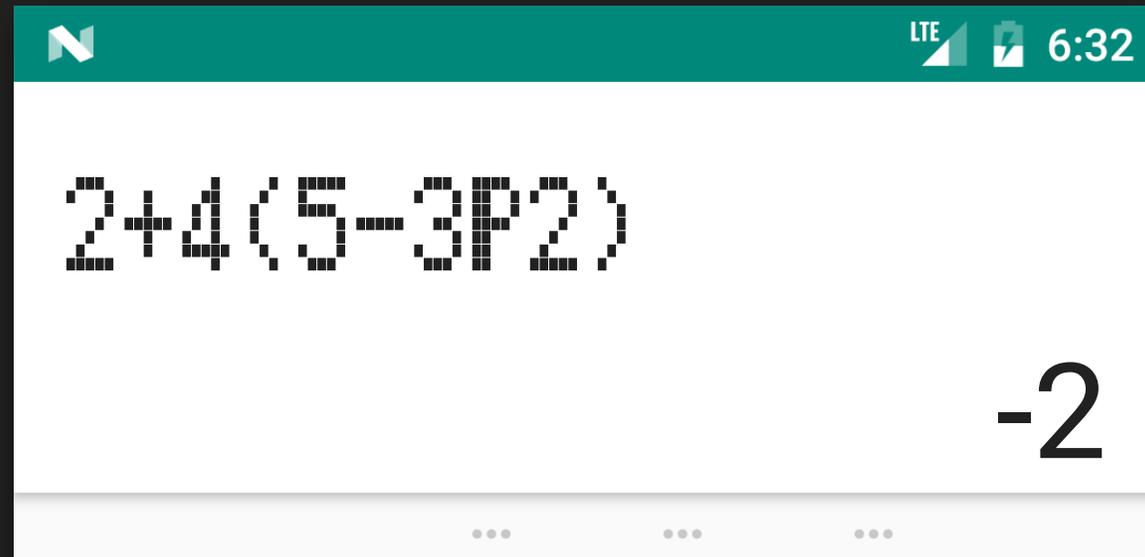
2+4(5-3\*2)

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

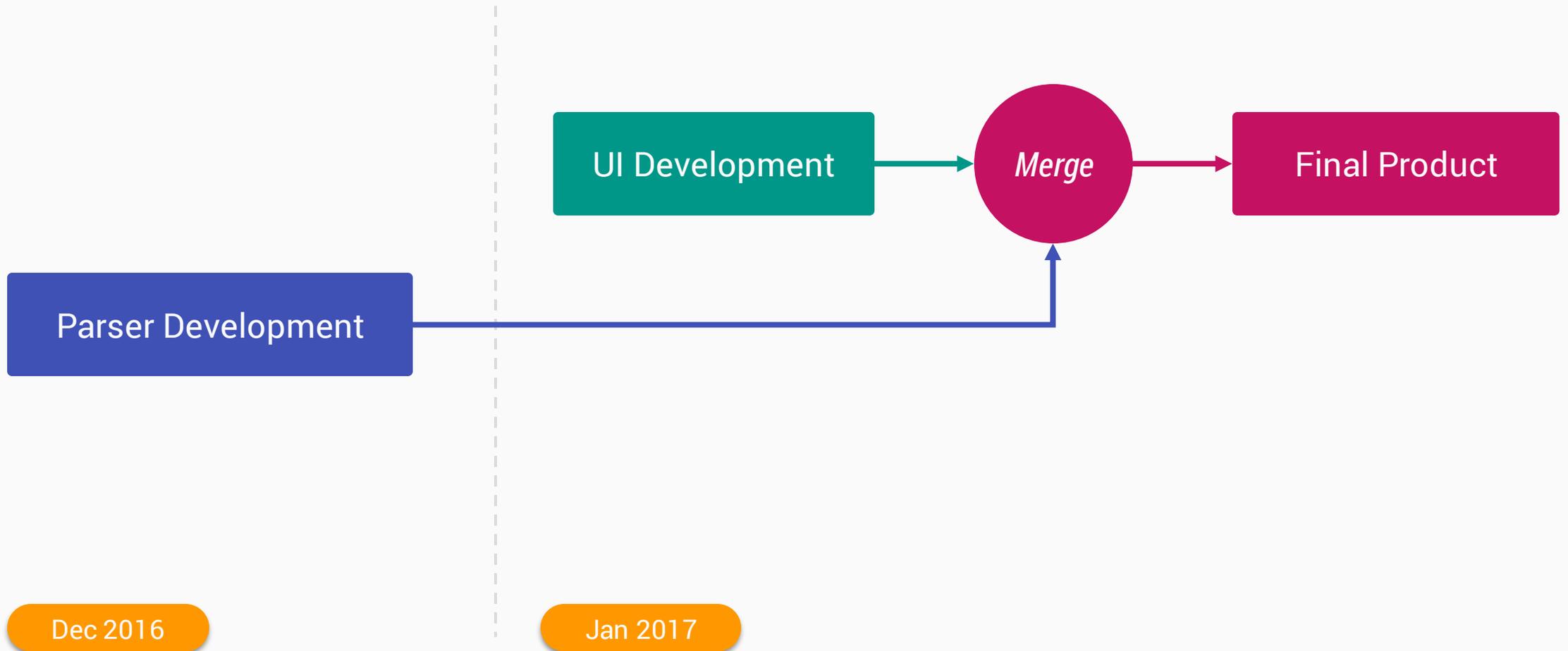
# Custom Display Font

The quick brown fox jumps over the lazy dog.

Αορεκ ιπρθκ δολορ σιτ ακετ, ηαδ νε ωιρι 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!

Download Procal Now

