MatrixMania

Matrix Programming Language

Cindy Espinosa, Desu Imudia, Diego Prado,
Sophie Reese-Wirpsa, Emily Ringel

Our Team

Cindy Espinosa
Tester

Desu Imudia
Language Guru

Diego Prado
System Architect

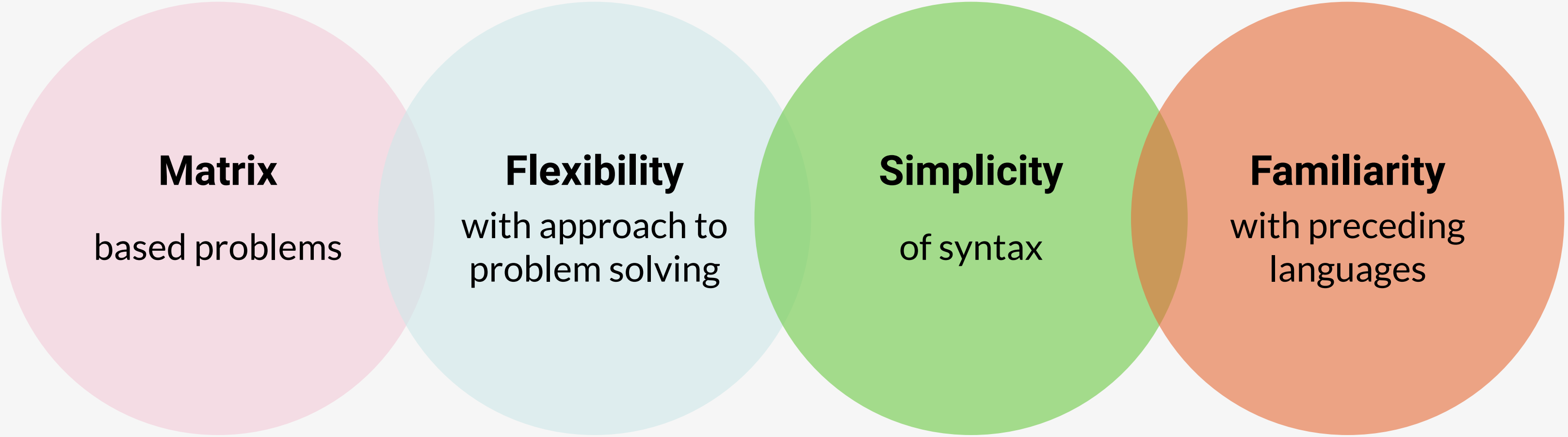
Emily Ringel
System Architect

Sophie Reese-Wirpsa
Project Manager

The Language

0.T&++1964↓3165∅1558963K4∩0

The Motivation



Matrix

based problems

Flexibility

with approach to problem solving

Simplicity

of syntax

Familiarity

with preceding languages

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So, what is MatrixMania?

- imperative programming language
- matrix manipulation
- linear algebra calculations
- Java-like syntax

MatrixMania Features

Matrix Data Type

Simple Control Flow

Matrix Functions

Basic Lexical Conventions

Matrix Operations

C-Programming Compatibility

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Language Overview

Data Types

```
int, float,
matrix, void
```

Comments

```
/* This is a comment
in MatrixMania */
```

Operators

```
=, *, /, %, +, -, <,
>, <=, >=, ==, !=,
&&, ||, !
```

Function Declarations & Scope

```
def int main() { return 0; }
def void example () {}
```

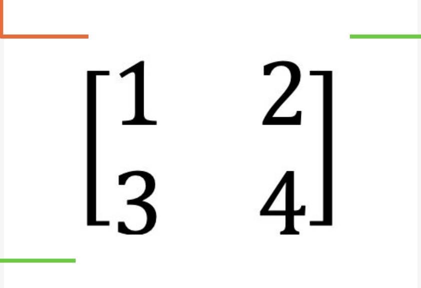
Control Flow

```
for (int i = 0; i < 2; i = i + 1) {}
while ( i < 2) {}
if (i < 2) {}  elif (i == 3) {}  else {}
```

Language Overview: Matrix Literal

MatrixMania Assignment

```
matrix<int> m = [1, 2; 3, 4];
matrix<float> n = [1.2, 7.3, 5.36];
```



$$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

Matrix Operations

```
int r = getRows(m);
int c = getColumns(m);
matrix <int> new_mat_add = m + n;
matrix <int> new_mat_sub = m - n;
matrix <int> new_mat_mult = m * n;
matrix <int> new_mat_scal = 2 * m;
```

Matrix Access & Reassign

```
int a = m[1, 0];
m[0,0] = 5;
```

The Implementation

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Process

Weekly Meetings

- discussed each member's progress over the week
- set deliverables for the next week

MatrixMania Functionality

- adapted MicroC code with features unique to our language
- used previous understanding of linear algebra computation to write built-in functions

MicroC Dissection

- referenced code for building blocks such as control flow and int/float operations

Program Testing

- added new tests iteratively with new functionality
- confirmed each new update did not break existing tests

Google Docs

LaTeX

GitHub

docker

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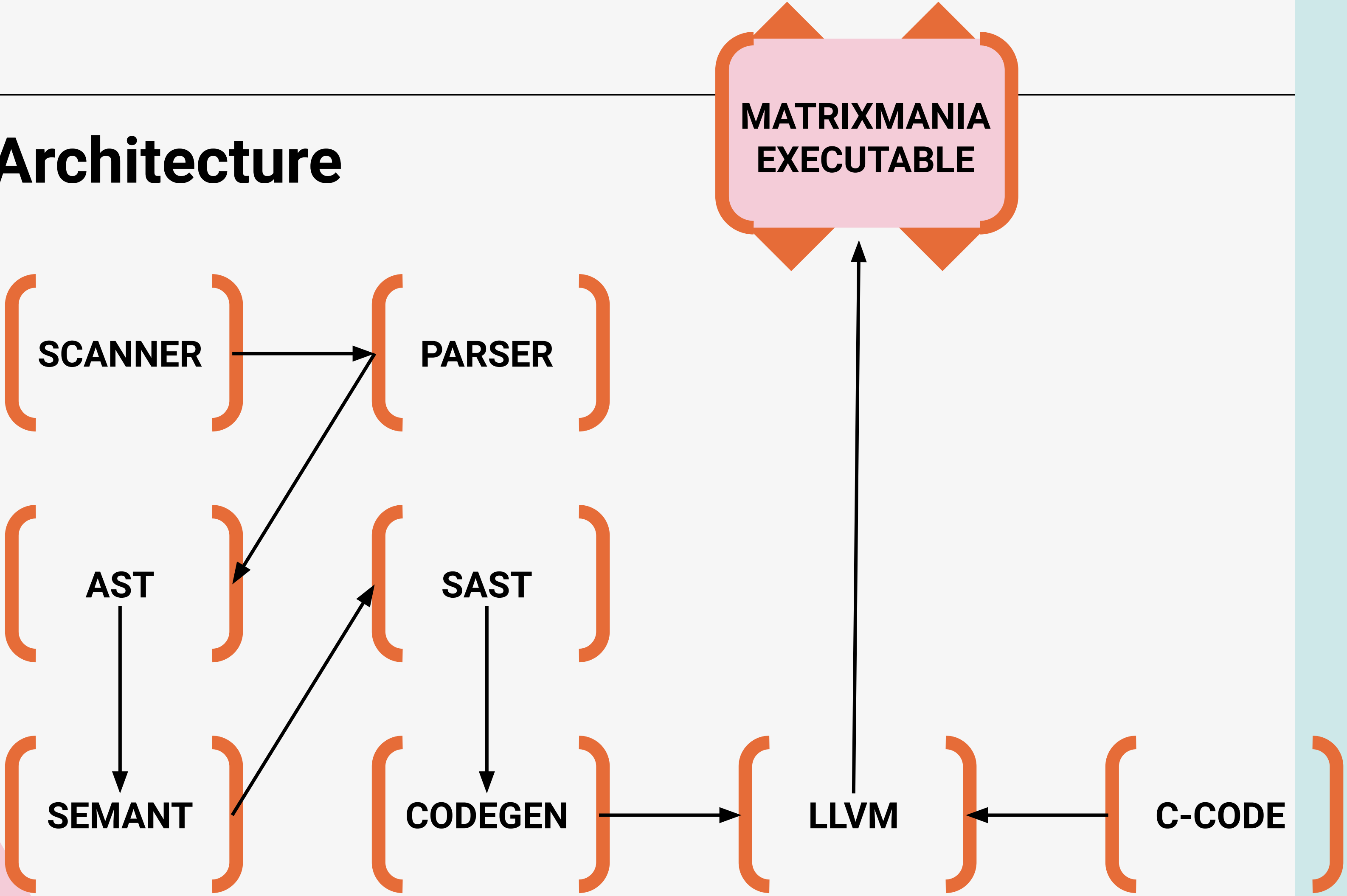
Architecture



MATRIXMANIA EXECUTABLE

SCANNER

PARSER

AST

SAST

SEMANT

CODEGEN

LLVM

C-CODE

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Implementation Highlights

```
def int main(){
    int a = 5;
    float b = a;
    float c = b - 3;
    float d = b;
    matrix<float> m1 = [0.0, b; c, d];
    matrix<float> m2 = [1.0, 1.0; 1.0, 1.0];
    printmf(m1*m2);
}
```

```
Output:

5.0 5.0
7.0 7.0
```

Flexible Variable Declaration

Int -> Float Casting

Matrix Operations

Internal Matrix Representation

Implementation Highlights

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}
```

Flexible Variable Declaration

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Matrix Operations

m1 in LLVM/C:

```
[2,2,0.0,5.0,2.0,5.0]
```

Internal Matrix Representation

The Future

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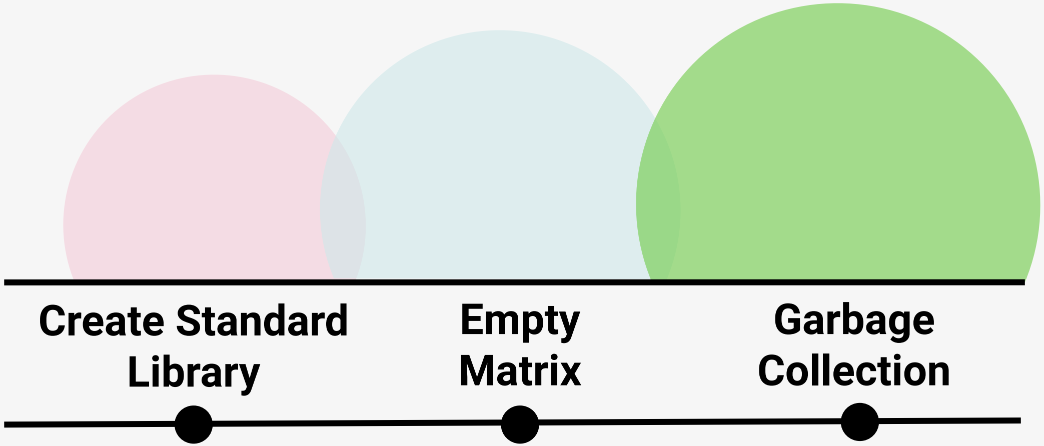
Future Work



Create Standard Library

Empty Matrix

Garbage Collection

The Code

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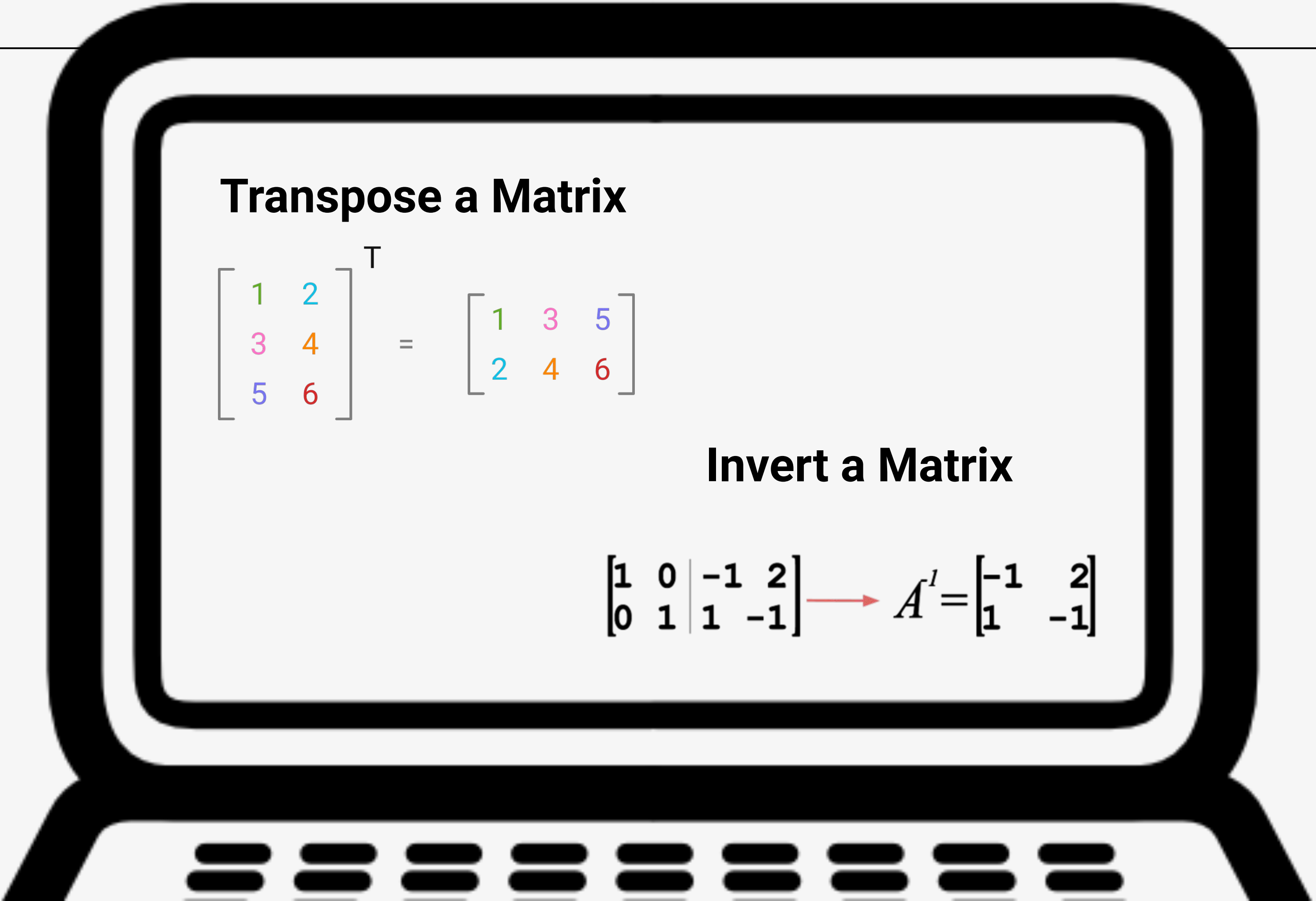
Demo



Transpose a Matrix

$$\begin{bmatrix}1&2\\3&4\\5&6\end{bmatrix}^{T} = \begin{bmatrix}1&3&5\\2&4&6\end{bmatrix}$$

Invert a Matrix

$$\left[\begin{array}{cc|cc}1&0&-1&2\\0&1&1&-1\end{array}\right]\longrightarrow A^{-1}=\begin{bmatrix}-1&2\\1&-1\end{bmatrix}$$

Thank you!

Questions?