You came early,
We appreciate it
Until we get started, we would like you to
do the following
1. Open Linux DSL user
2. If you don't have a Github account
   a. Create one
3. Connect to the server and share your
   details
4. If you are still bored waiting,
   a. apply for Github student developer pack

#Pragma

Welcome

Who are we?

Who are you?

- Name
- Course
- Hobby

Why are you here?

Why ~~are you here?~~
do you want to give your 2 hours of precious time to us?

What we have in our mind?

Your Favorite Language

This is my
favorite
images of
all times

| Problem |
| --- |
| Algorithms |
| Program |
| ISA (Instruction Set Arch) |
| Microarchitecture |
| Circuits |
| Electrons |

If you didn't like that

AN x64 PROCESSOR IS SCREAMING ALONG AT BILLIONS OF CYCLES PER SECOND TO RUN THE XNU KERNEL, WHICH IS FRANTICALLY WORKING THROUGH ALL THE POSIX-SPECIFIED ABSTRACTION TO CREATE THE DARWIN SYSTEM UNDERLYING OS X, WHICH IN TURN IS STRAINING ITSELF TO RUN FIREFOX AND ITS GECKO RENDERER, WHICH CREATES A FLASH OBJECT WHICH RENDERS DOZENS OF VIDEO FRAMES EVERY SECOND

BECAUSE I WANTED TO SEE A CAT JUMP INTO A BOX AND FALL OVER.

I AM A GOD.

Let's talk code

Problem
Algorithms
Program
ISA (Instruction Set Arch)
Microarchitecture
Circuits
Electrons
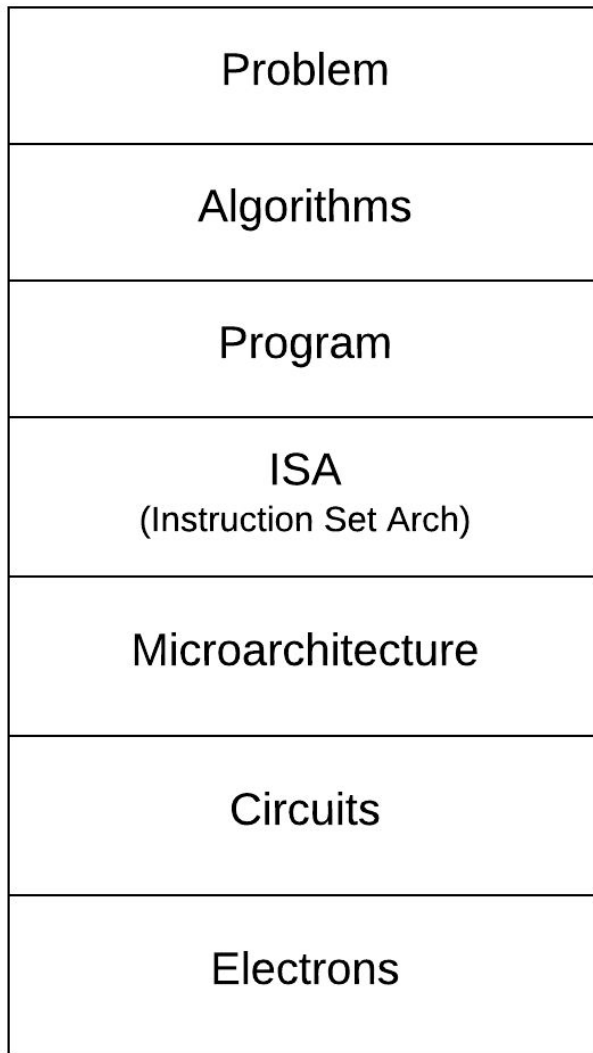
THIS

```
for(int i = 0; i < n; i++){
    a[i] = a[i] + 1;
}
```

THIS

```
for(int i = 0; i < n; i++){
    a[i] = a[i] + 1;
}
```

THAT

```
for(int& i : a){
    i++;
}
```

Fun fact: What are Python Lists?

Fun fact: What are
Python Lists?
It is just a dynamic
array(think about it)

How many of you know Matrix Multiply?

C = A x B

1	2	3
4	5	6
7	8	9

X

1	2	3
4	5	6
7	8	9

30	36	42
66	81	96
102	126	150

A

1	2	3
4	5	6
7	8	9

X

B

1	2	3
4	5	6
7	8	9

C

30	36	42
66	81	96
102	126	150

A

1	2	3
4	5	6
7	8	9

X

B

1	2	3
4	5	6
7	8	9

C

30	36	42
66	81	96
102	126	150

Write a code to do Matrix Multiplication

Matrix Multiply Speedup Over Native Python
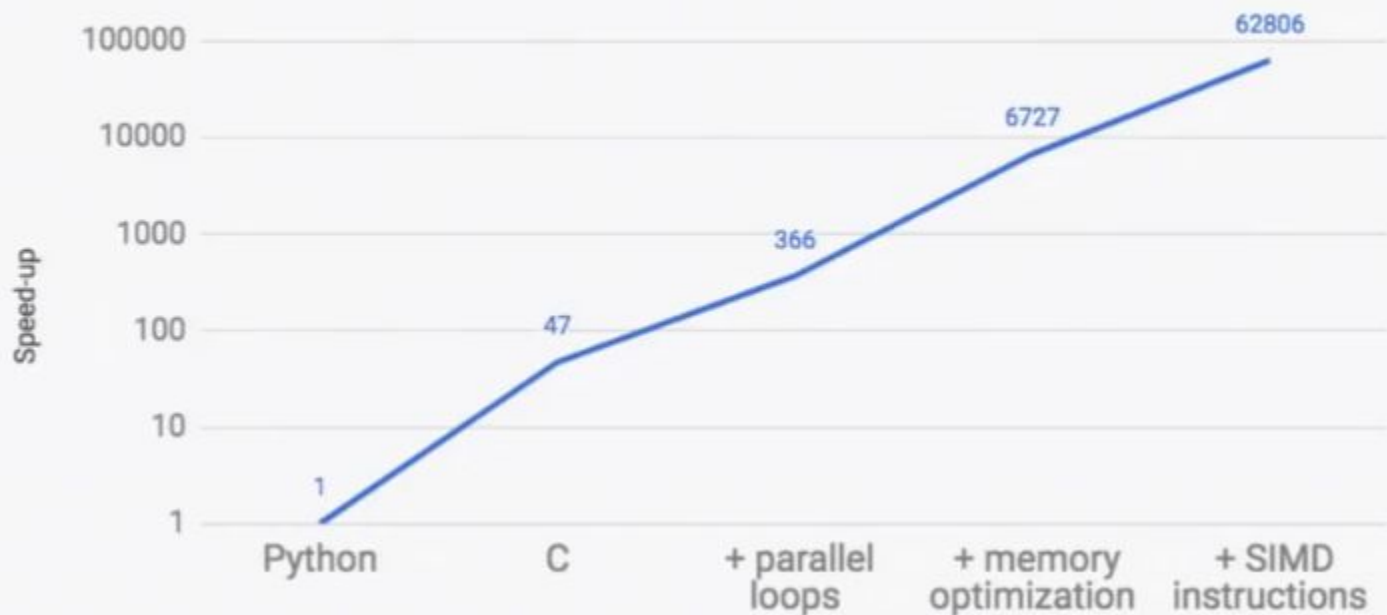
```python
def matrix_multiply(A, B, C):
for i in range(len(A)):
    for j in range(len(B[0])):
        for k in range(len(B)):
            C[i][j] += A[i][k] * B[k][j]
```
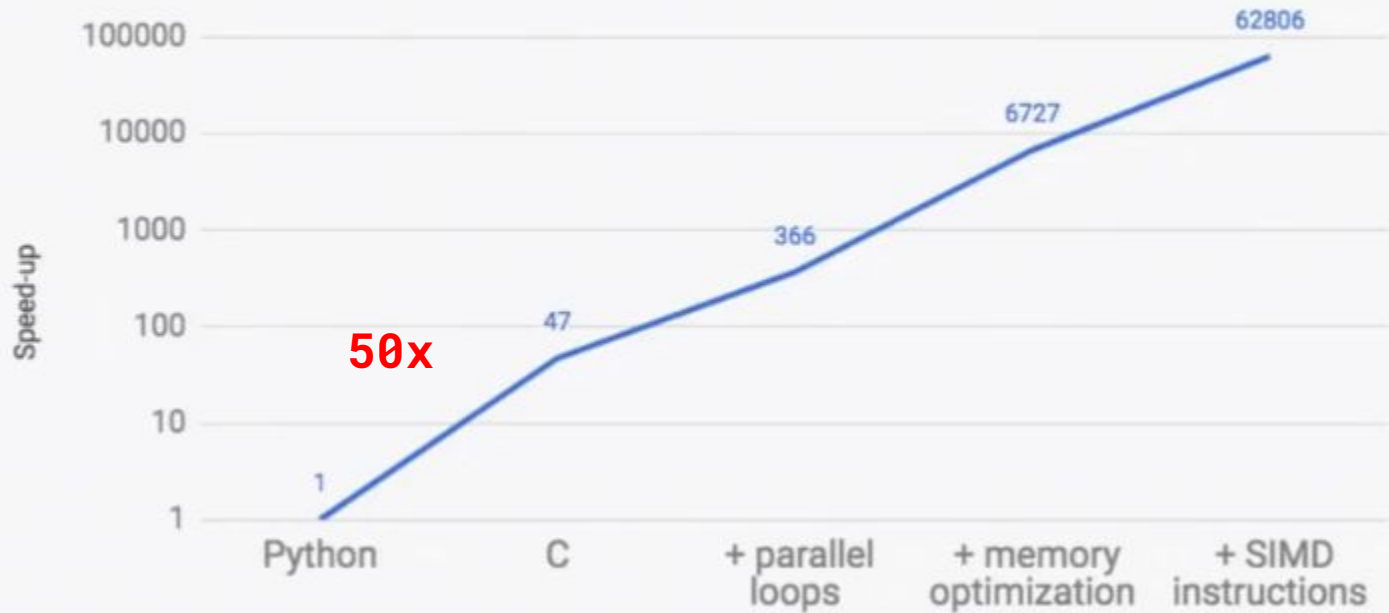
Matrix Multiply Speedup Over Native Python
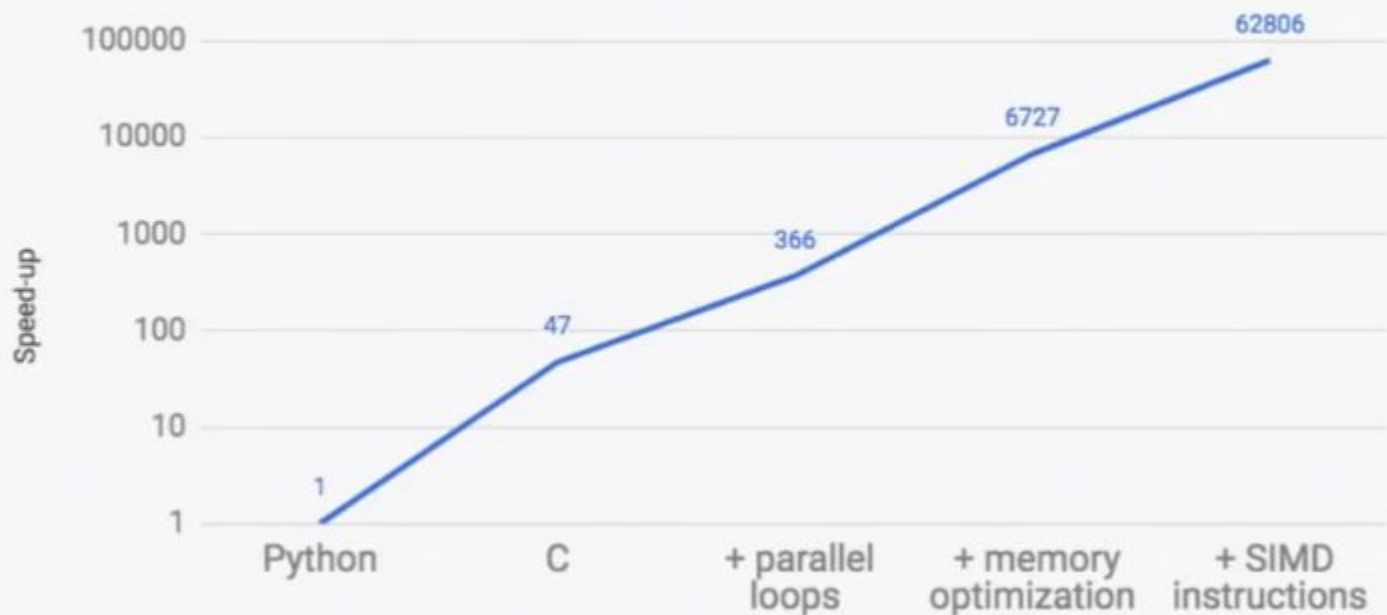
Fun fact: Python2 input vulnerability

Fun fact: Python2 input vulnerability Please refer "Hackin" round 8

```c
int matrix_multiplication(int *A, int *B, int *C, int m,
                          int n, int o){
    #pragma parallel
    for(int i = 0; i < m; i++){
        for(int j = 0; j < n; j++){
            for(int k = 0; k < o; k++){
                C[i * m + j] = A[i * m + k] * B[k * o + j];
            }
        }
    }
}
```
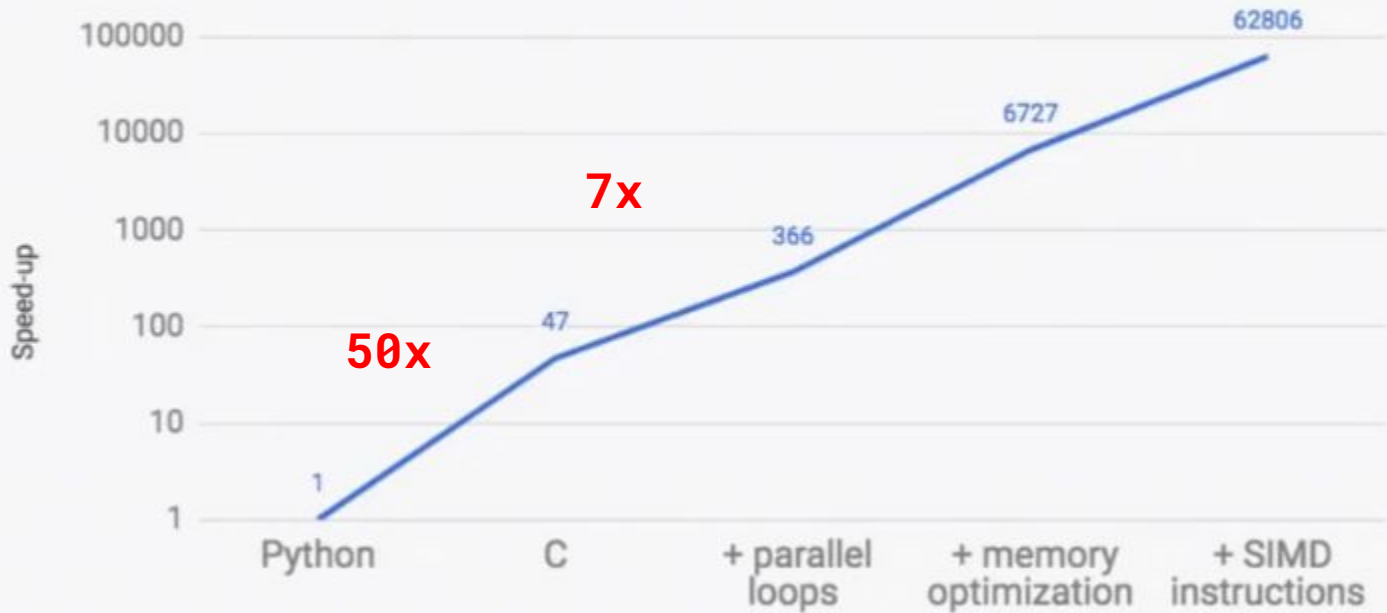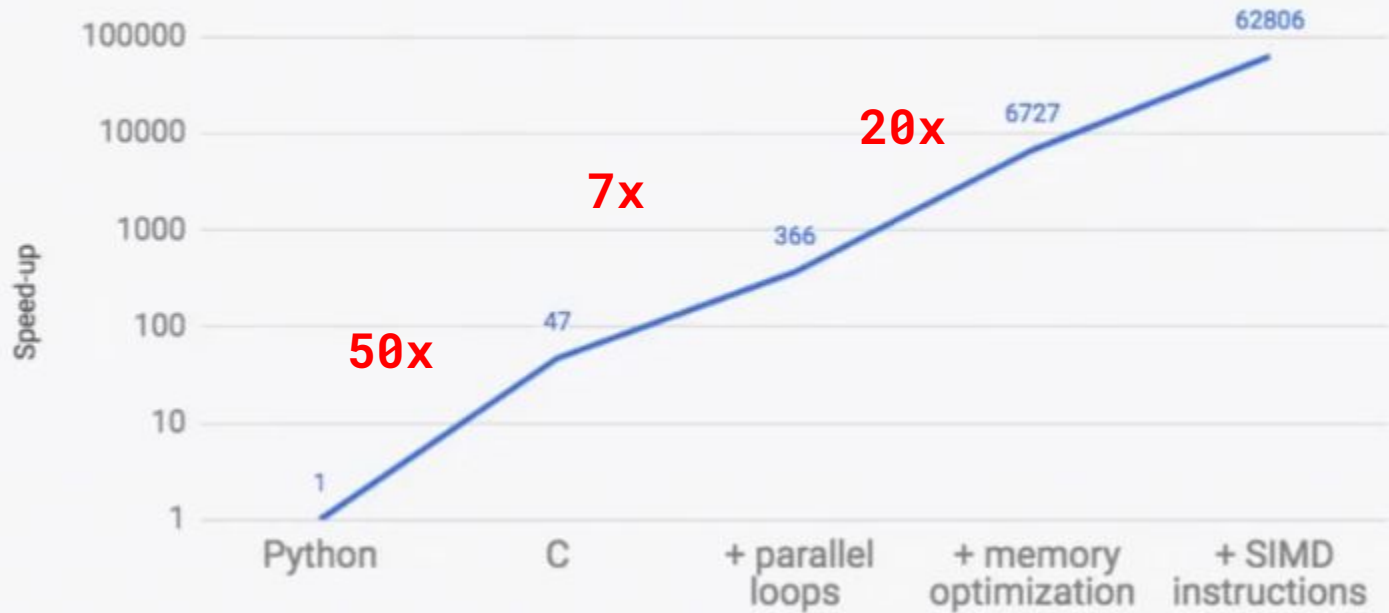
Matrix Multiply Speedup Over Native Python

```c
int matrix_multiplication(int *A, int *B, int *C, int m,
                          int n, int o){
    #pragma parallel
    for(int i = 0; i < m; i++){
        for(int k = 0; k < o; k++){
            for(int j = 0; j < n; j++){
                C[i * m + j] = A[i * m + k] * B[k * o + j];
            }
        }
    }
}
```
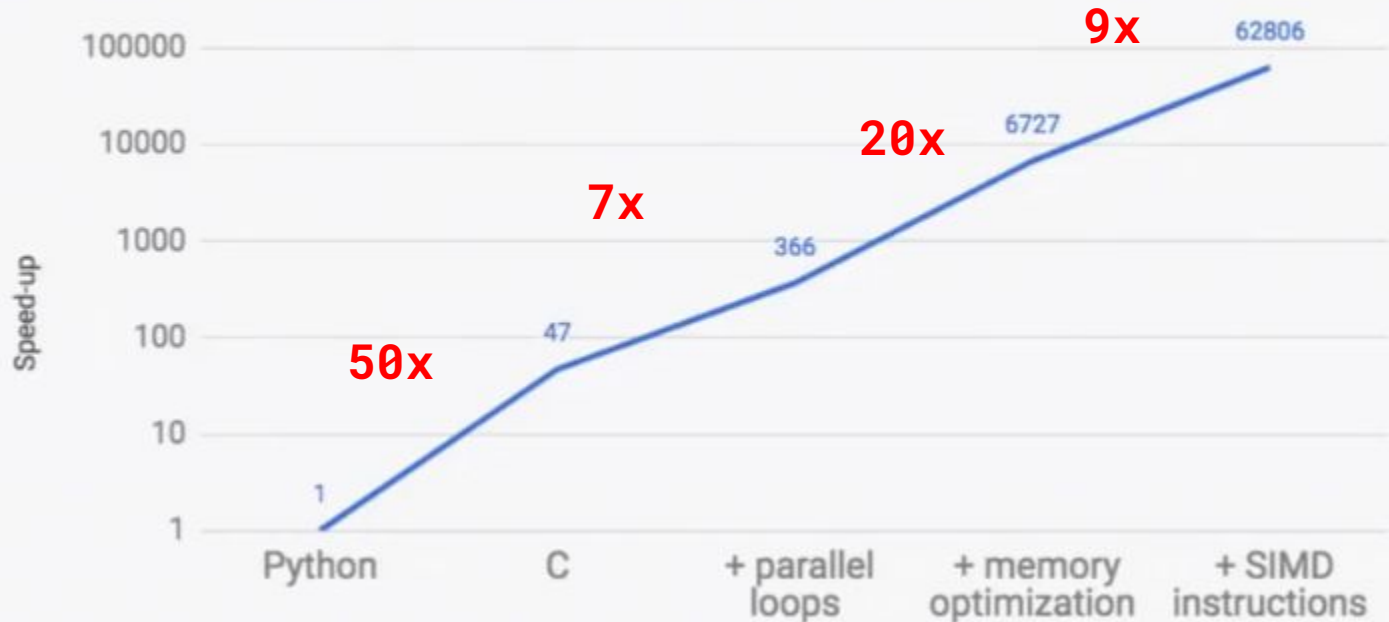
+ Register blocking

Matrix Multiply Speedup Over Native Python

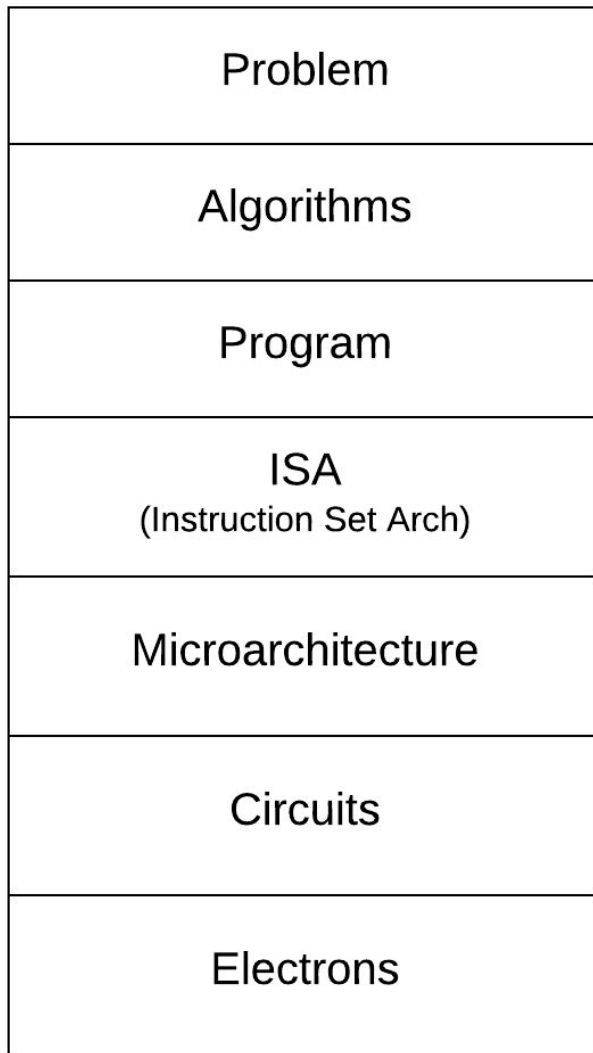Matrix Multiply Speedup Over Native Python

Matrix Multiply Speedup Over Native Python

Now assembly + Sorry out
of slide space

We need the
right
abstraction
for
performance

Problem
Algorithms
Program
ISA (Instruction Set Arch)
Microarchitecture
Circuits
Electrons

We need the right abstraction for everything

Problem
Algorithms
Program
ISA (Instruction Set Arch)
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