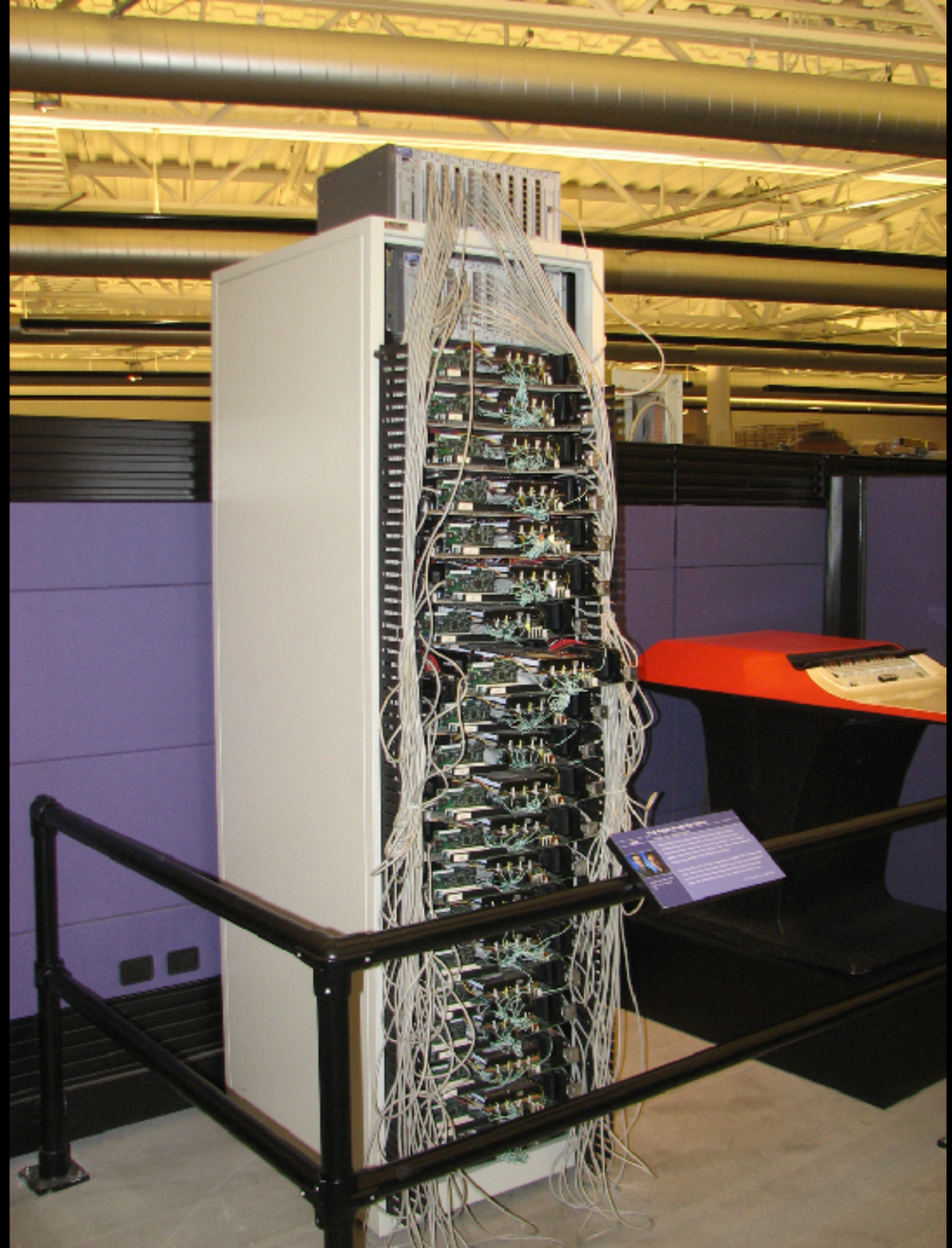
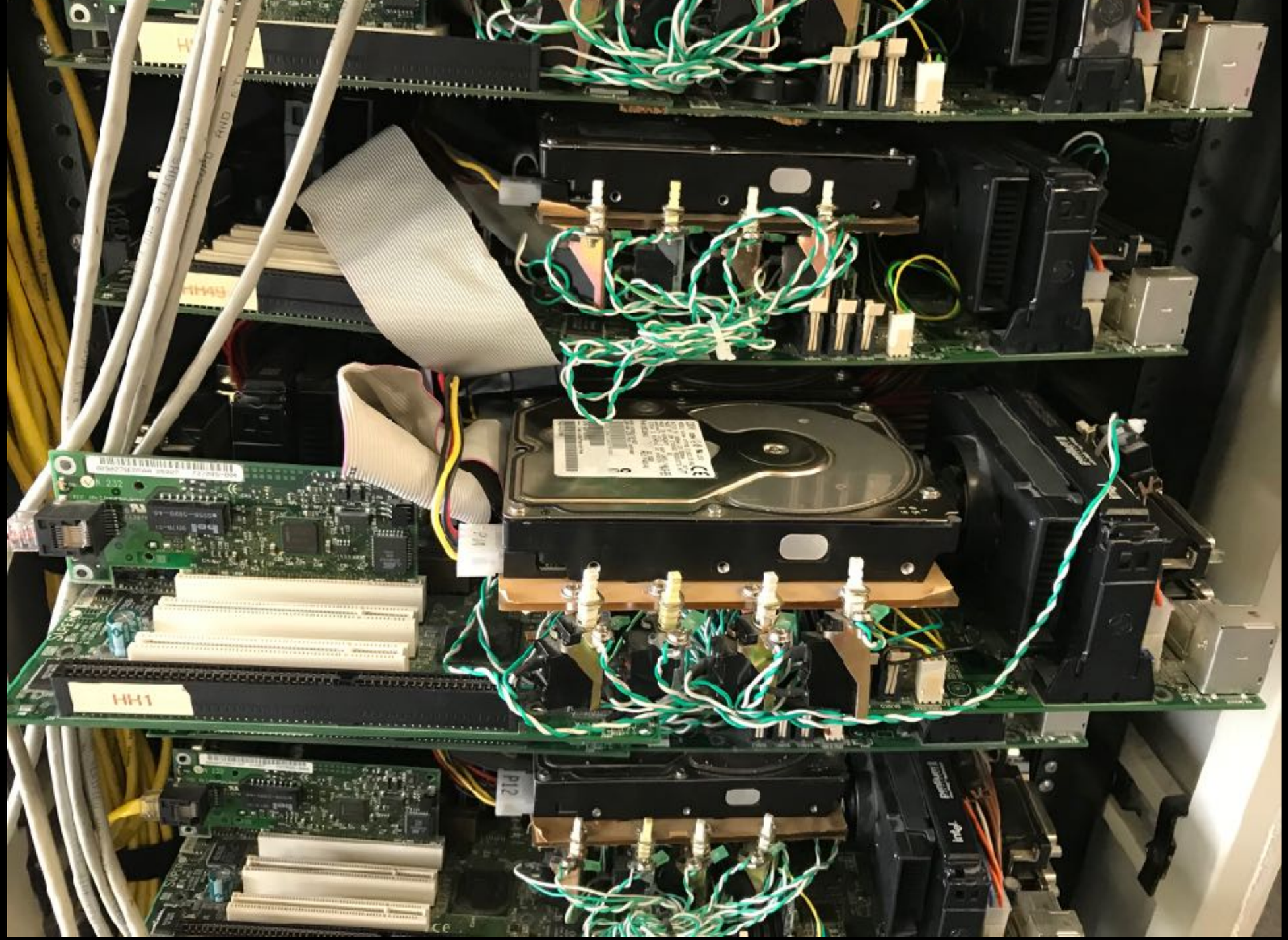
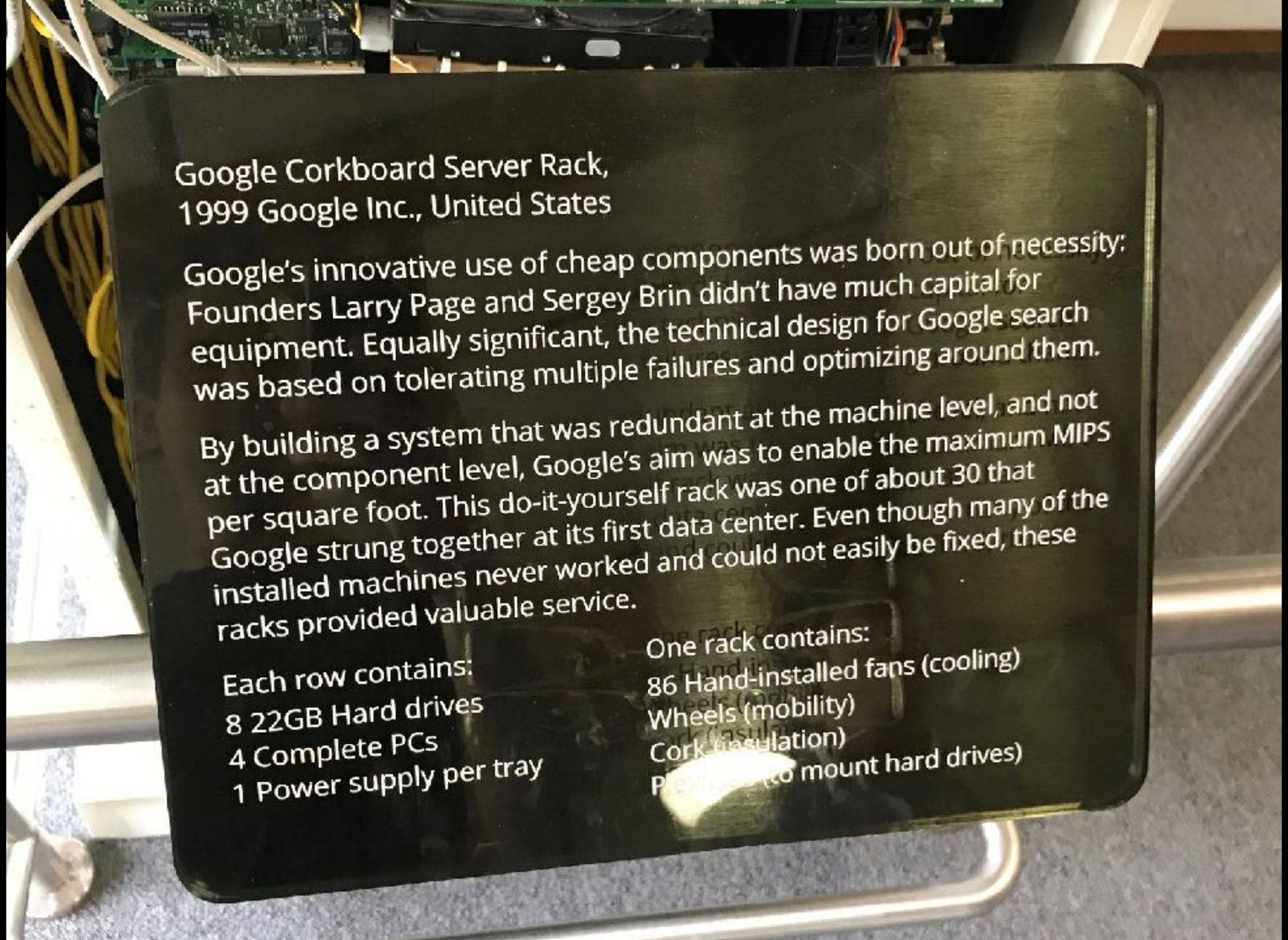
CS50



wikipedia.org


HH1



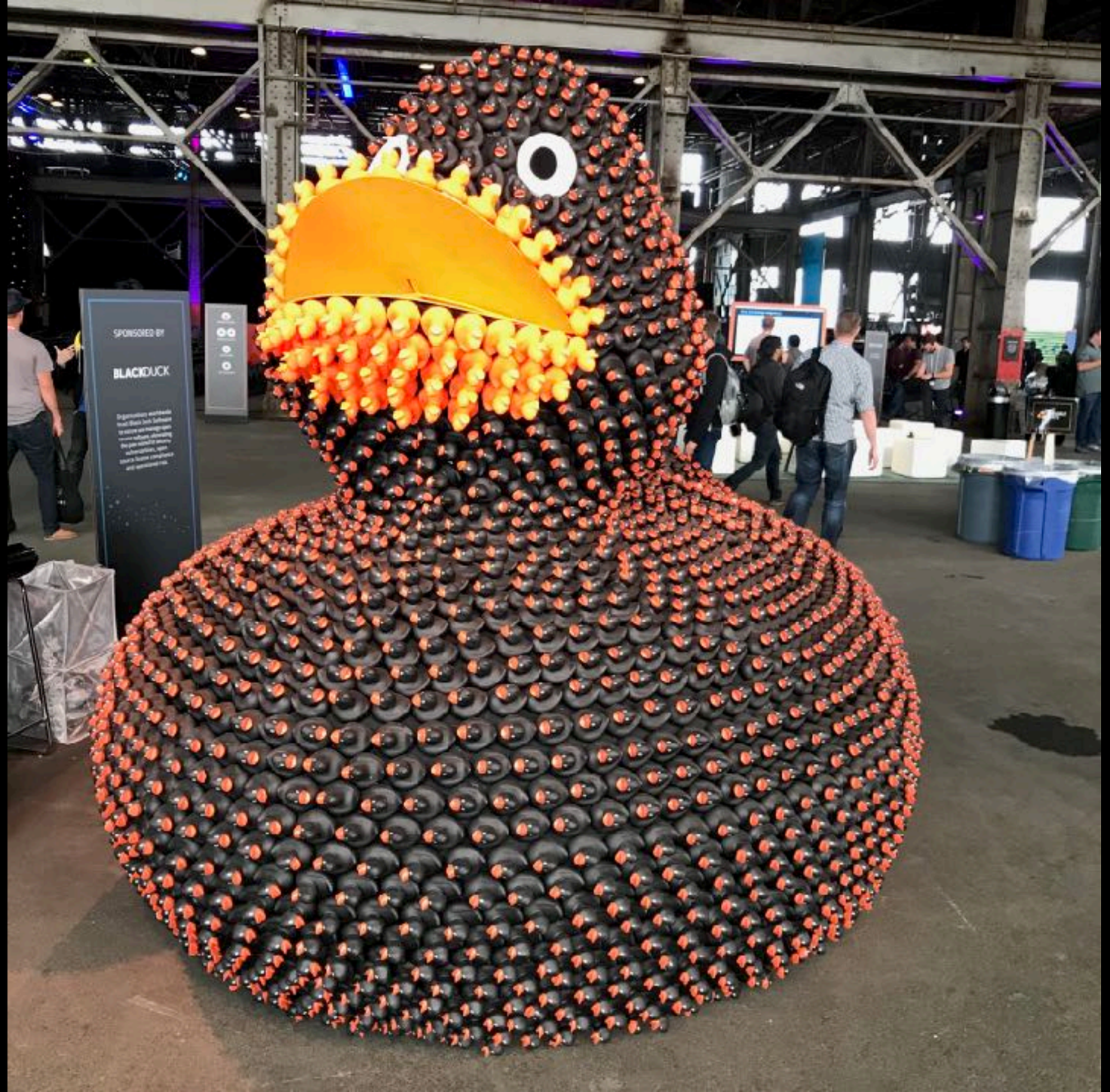
Google Corkboard Server Rack,
1999 Google Inc., United States

Google's innovative use of cheap components was born out of necessity: Founders Larry Page and Sergey Brin didn't have much capital for equipment. Equally significant, the technical design for Google search was based on tolerating multiple failures and optimizing around them.

By building a system that was redundant at the machine level, and not at the component level, Google's aim was to enable the maximum MIPS per square foot. This do-it-yourself rack was one of about 30 that Google strung together at its first data center. Even though many of the installed machines never worked and could not easily be fixed, these racks provided valuable service.

Each row contains:
8 22GB Hard drives
4 Complete PCs
1 Power supply per tray

One rack contains:
86 Hand-installed fans (cooling)
Wheels (mobility)
Cork (insulation)
[illegible] to mount hard drives)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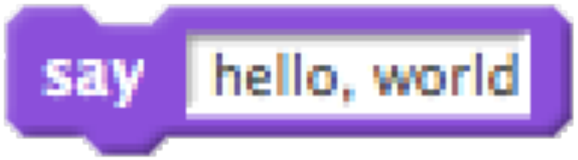
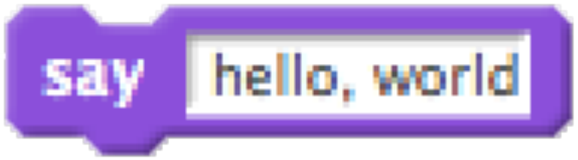
C

Python




```
printf("hello, world\n");
```




```
print("hello, world")
```


```c
#include <stdio.h>

int main(void)
{
    printf("hello, world\n");
}
```


```
def main():
    print("hello, world")

if __name__ == "__main__":
    main()
```


```
def main():
    print("hello, world")

if __name__ == "__main__":
    main()
```


```
def main():
    print("hello, world")

if __name__ == "__main__":
    main()
```


```
def main():
    print("hello, world")

if __name__ == "__main__":
    main()
```


```
def main():
····print("hello, world")

if __name__ == "__main__":
····main()
```


forever
say
hello, world


```
while (true)
{
    printf("hello, world\n");
}
```


```
while True:
    print("hello, world")
```


```
while True:
    print("hello, world")
```

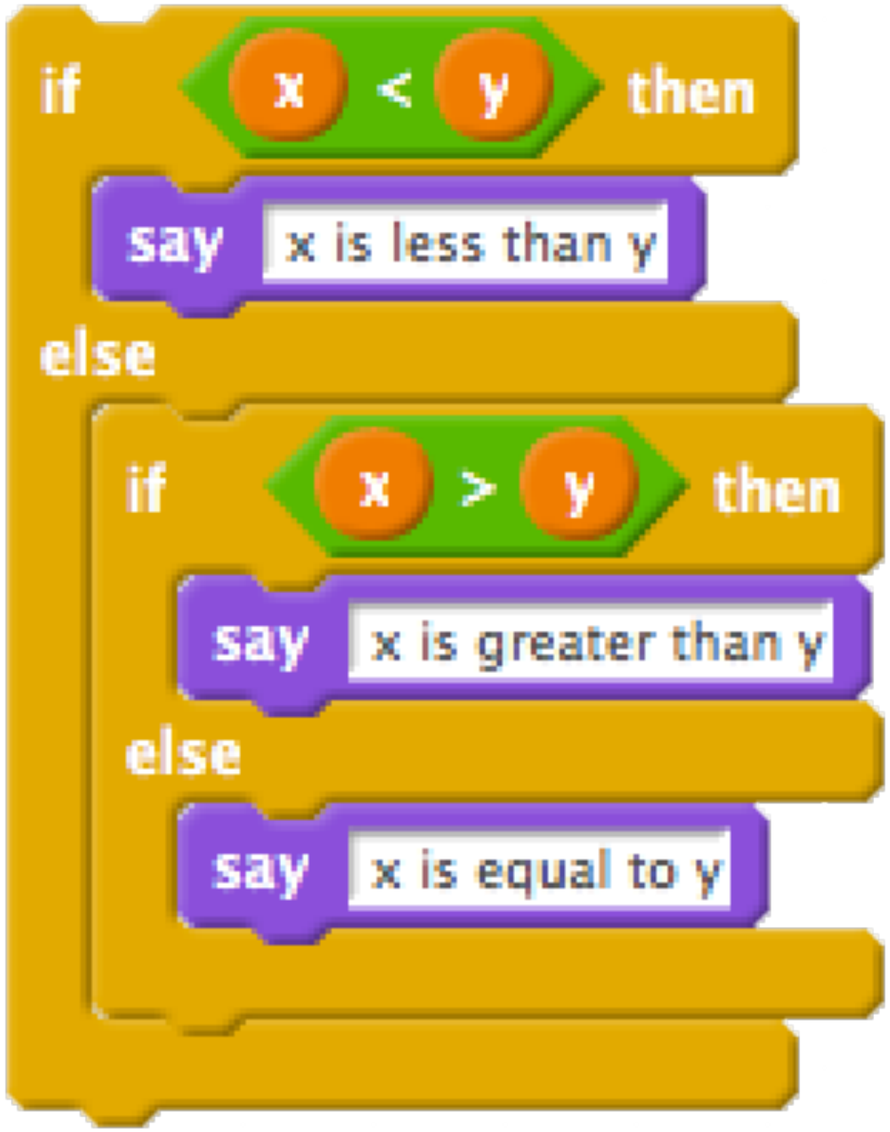

repeat
50
say
hello, world

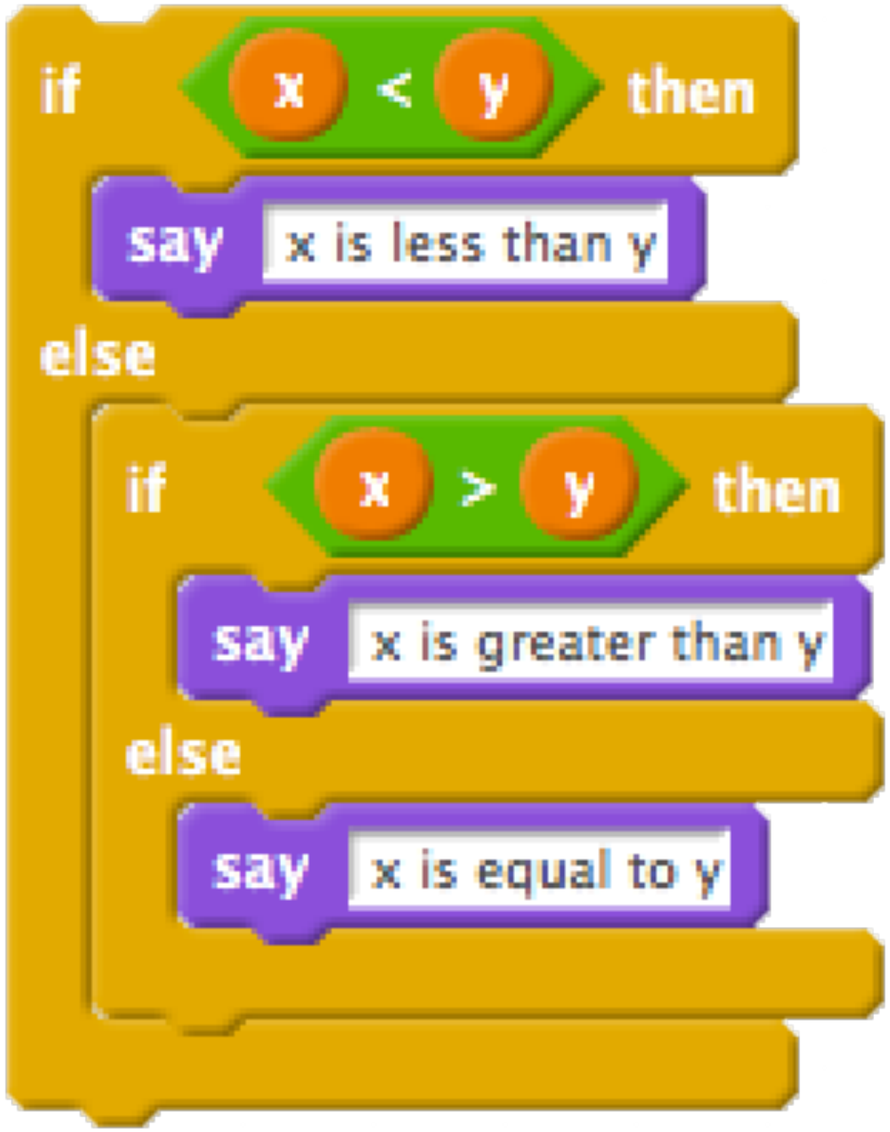

```
for (int i = 0; i < 50; i++)
{
    printf("hello, world\n");
}
```


```
for i in range(50):
    print("hello, world")
```

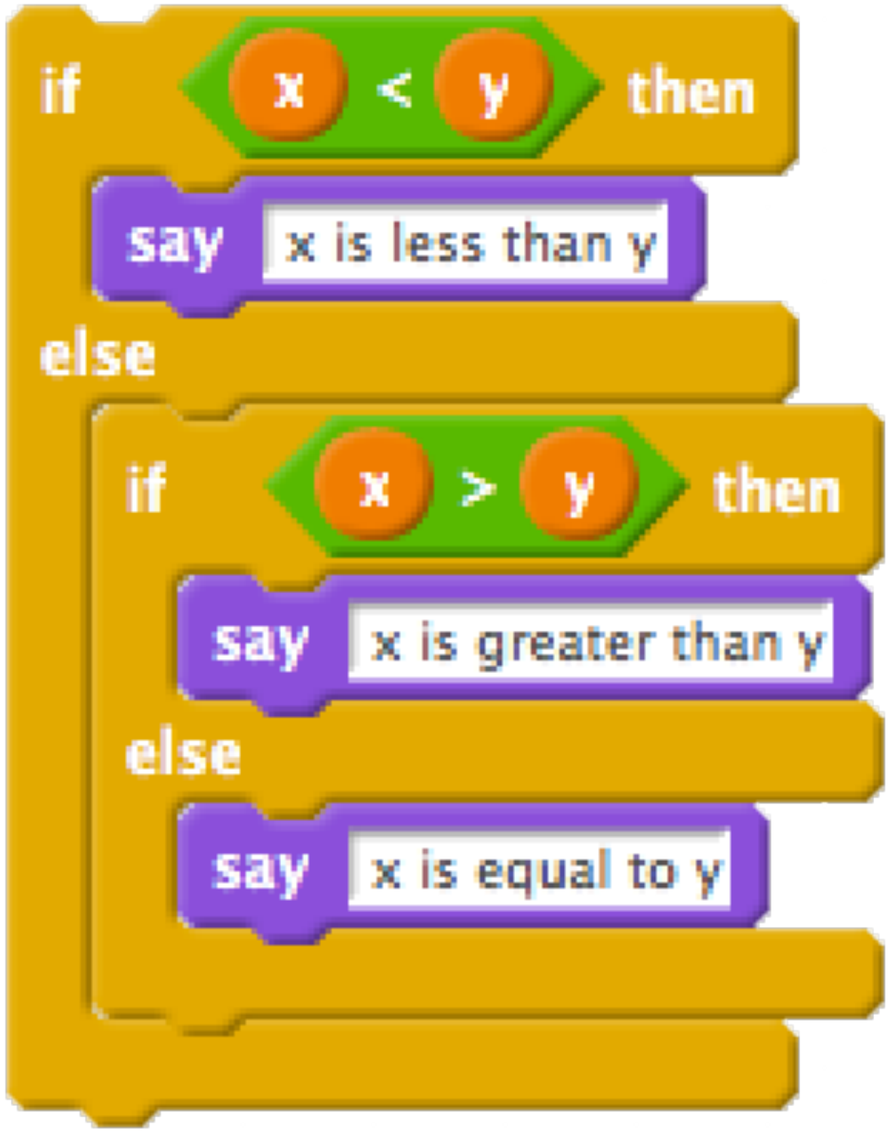

```
for i in range(50):
    print("hello, world")
```


```
for i in range(50):
    print("hello, world")
```

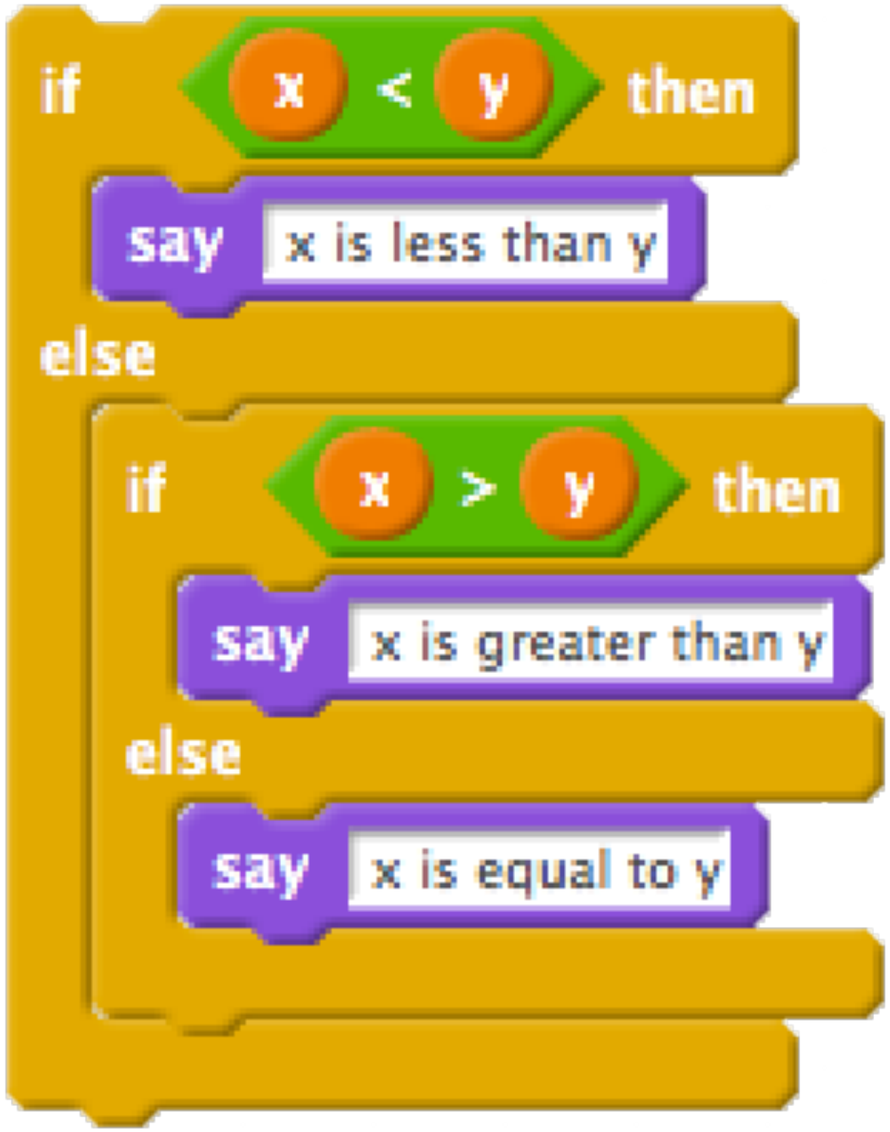

if x < y then
say x is less than y
else
if x > y then
say x is greater than y
else
say x is equal to y




```
if (x < y)
{
    printf("x is less than y\n");
}
else if (x > y)
{
    printf("x is greater than y\n");
}
else
{
    printf("x is equal to y\n");
}
```

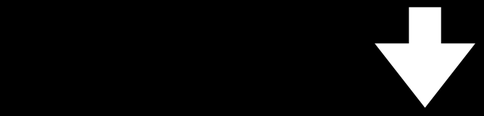



```
if x < y:
    print("x is less than y")
elif x > y:
    print("x is greater than y")
else:
    print("x is equal to y")
```

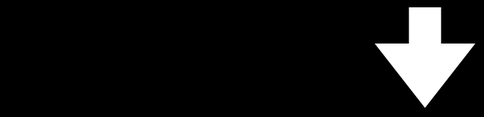



```
if x < y:
    print("x is less than y")
elif x > y:
    print("x is greater than y")
else:
    print("x is equal to y")
```

source code



compiler



machine code

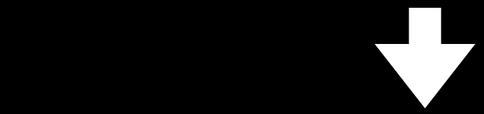
```c
#include <stdio.h>

int main(void)
{
    printf("hello, world\n");
}
```

```
clang hello.c
```

```
01111111 01000101 01001100 01000110 00000010 00000001 00000001 00000000
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
00000010 00000000 00111110 00000000 00000001 00000000 00000000 00000000
10110000 00000101 01000000 00000000 00000000 00000000 00000000 00000000
01000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
11010000 00010011 00000000 00000000 00000000 00000000 00000000 00000000
00000000 00000000 00000000 00000000 01000000 00000000 00111000 00000000
00001001 00000000 01000000 00000000 00100100 00000000 00100001 00000000
00000110 00000000 00000000 00000000 00000101 00000000 00000000 00000000
01000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
01000000 00000000 01000000 00000000 00000000 00000000 00000000 00000000
01000000 00000000 01000000 00000000 00000000 00000000 00000000 00000000
11111000 00000001 00000000 00000000 00000000 00000000 00000000 00000000
11111000 00000001 00000000 00000000 00000000 00000000 00000000 00000000
00001000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
00000011 00000000 00000000 00000000 00000100 00000000 00000000 00000000
00111000 00000010 00000000 00000000 00000000 00000000 00000000 00000000
00111000 00000010 01000000 00000000 00000000 00000000 00000000 00000000
00111000 00000010 01000000 00000000 00000000 00000000 00000000 00000000
00011100 00000000 00000000 00000000 00000000 00000000 00000000 00000000
...
```

```
./a.out
```

source code

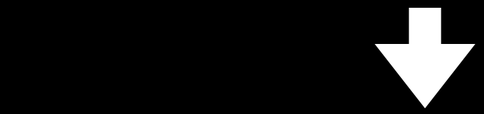


interpreter

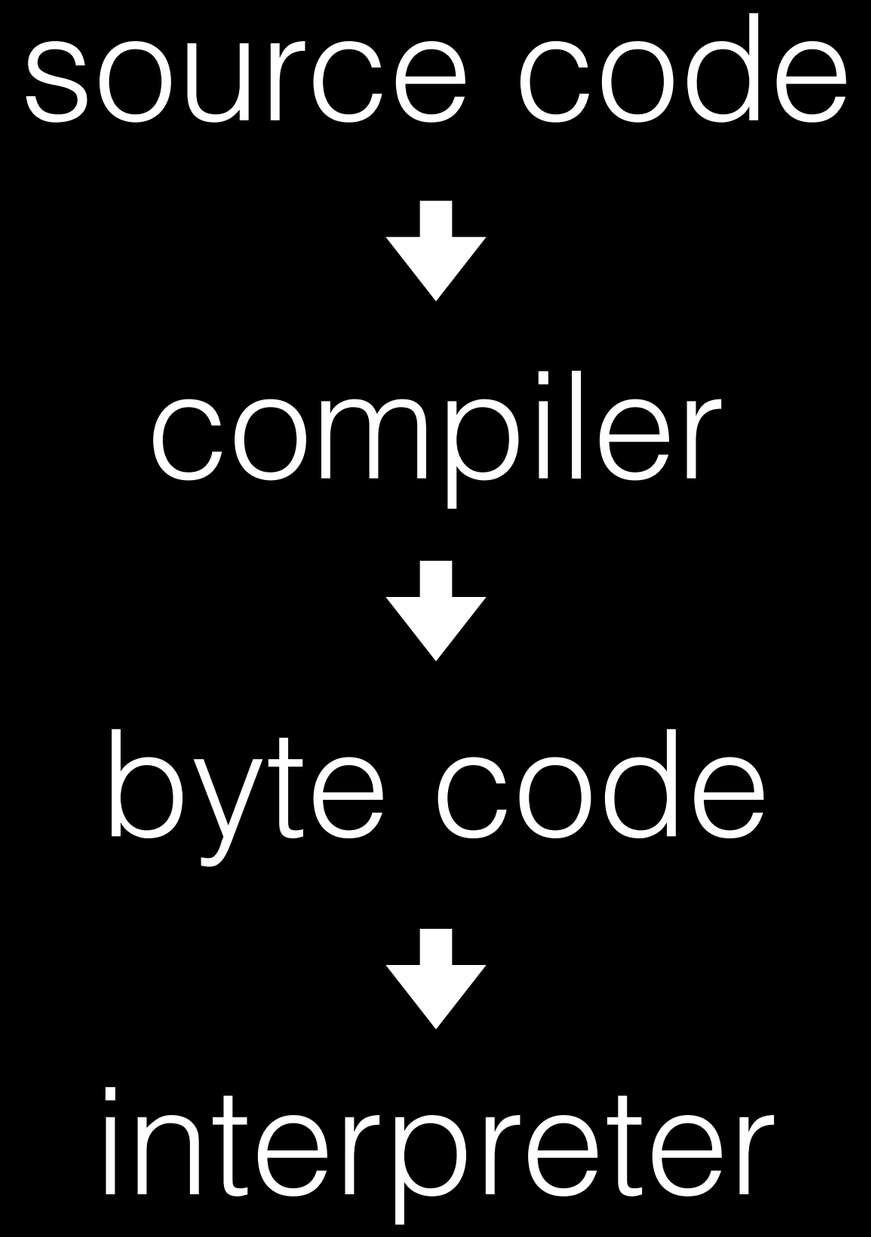
```
def main():
    print("hello, world")
```

```
python hello.py
```

source code

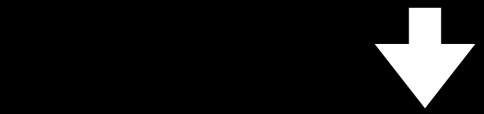


interpreter


source code
compiler
byte code
interpreter

```
2           0 LOAD_GLOBAL              0 (print)
            3 LOAD_CONST               1 ('hello, world')
            6 CALL_FUNCTION            1 (1 positional, 0 keyword pair)
            9 POP_TOP
           10 LOAD_CONST               0 (None)
           13 RETURN_VALUE
```

source code



interpreter

```
bool

float

int

str

...
```

```
get_char

get_float

get_int

get_string

...
```

```
...
complex
dict
list
range
set
tuple
...
```

CS50