C Review
Pointers, Arrays, and I/O

CS61c Summer 2006

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C Advice

- Draw stuff out
  - Variables are boxes, pointers are arrows
- Give a type your variables!
- & returns a value whose type has one more star than the type of the variable
  - int quux; int* baz = &quux;
- Execute the fundamental operations one at a time
  - variable lookup, pointer deference, etc

Tracing Pointers – Warm Up

What will y contain?

```
int main(int argc, char** argv)
{
  int y, *z;
  y = 4;
  z = &y;
  y = *z + 9;
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}
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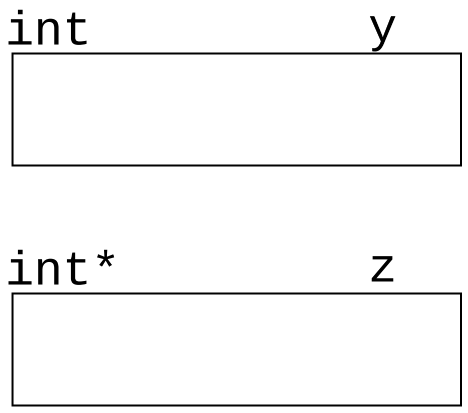

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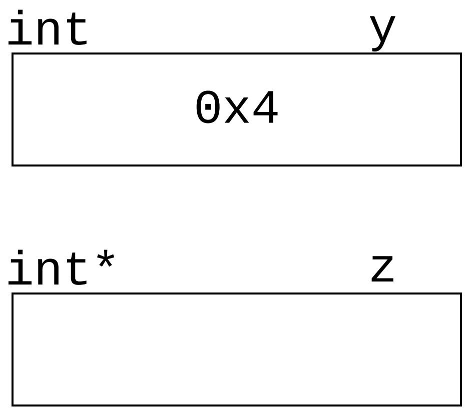

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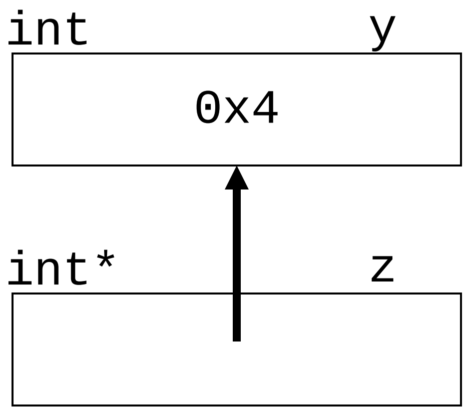

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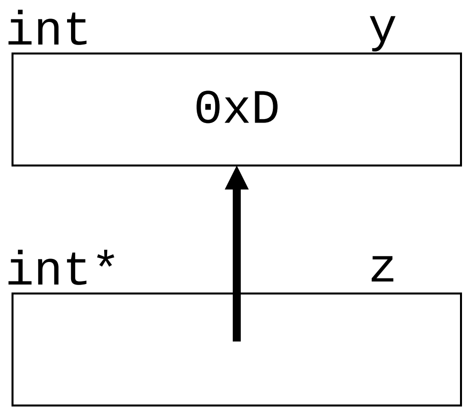

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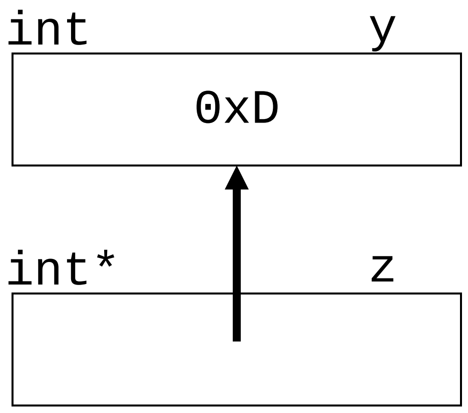

It contains 0xD. What is that in binary? In decimal?

Tracing Pointers – More Levels

What is in foo and bar at the end of this program?

```
int main(int argc, char** argv)
{
  int foo, *bar, **baz, quux;
  bar = &quux;
  foo = 4;
  baz = &bar;
  **baz = 13;
  bar = &foo;
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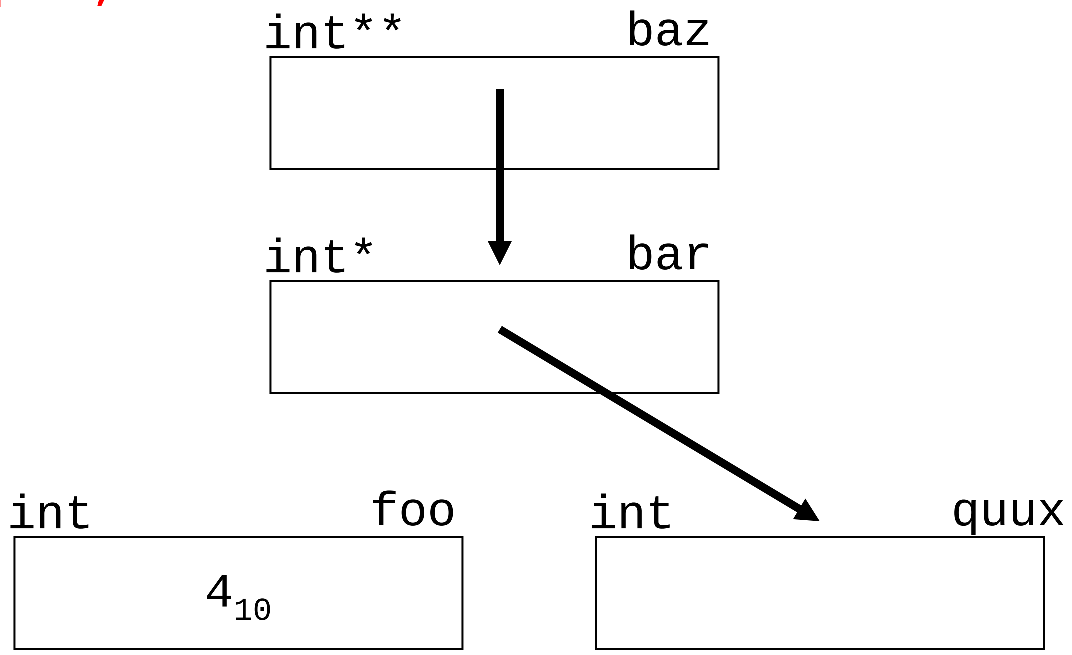

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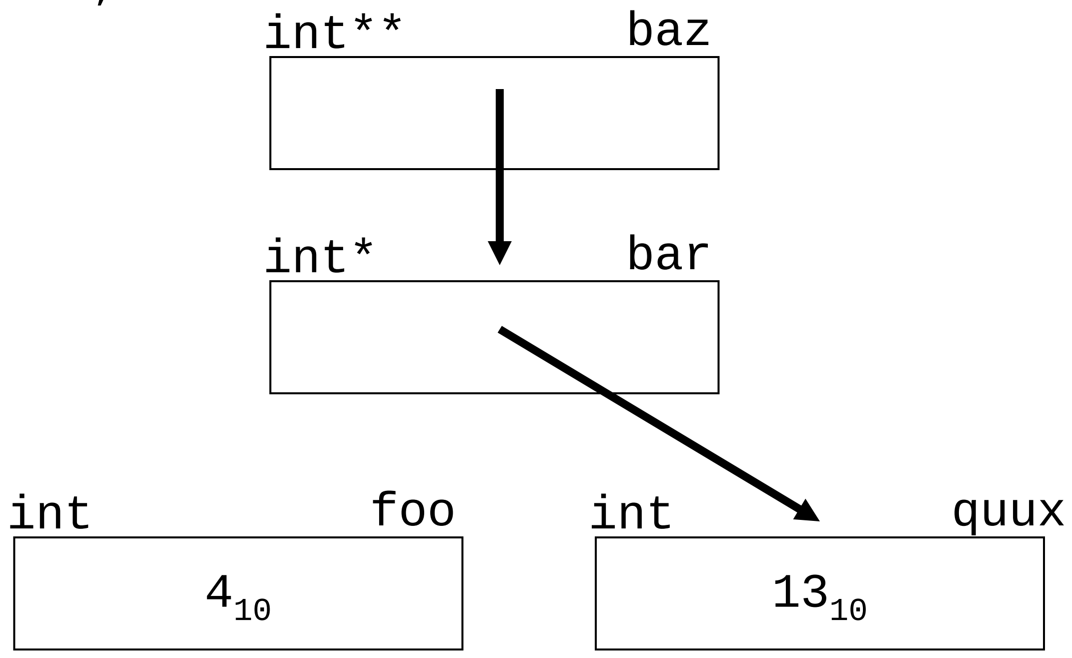

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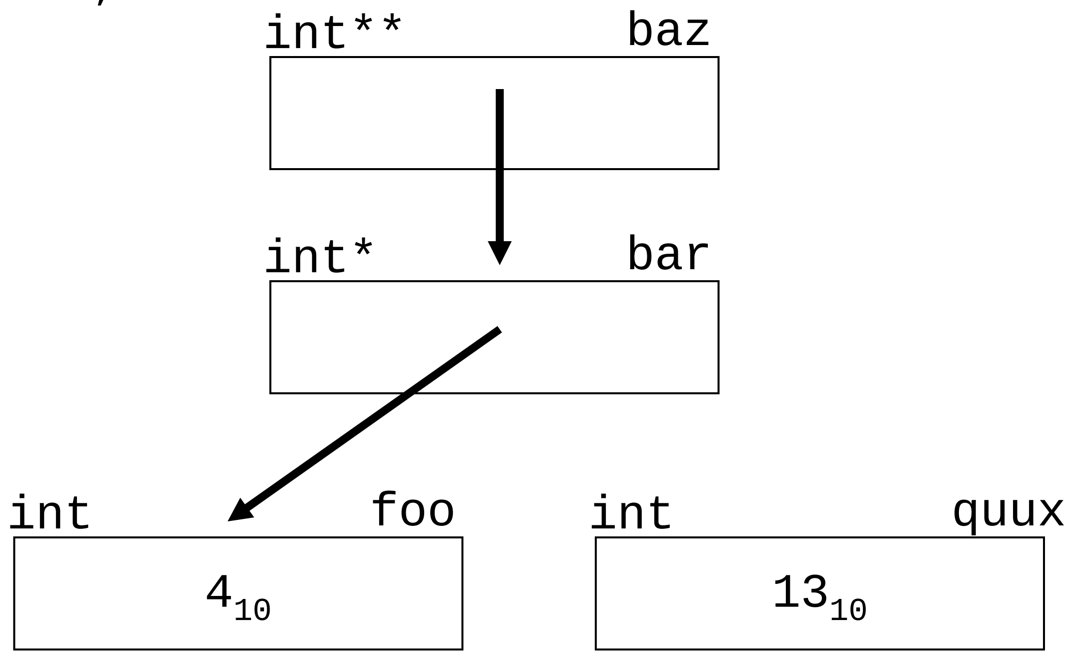

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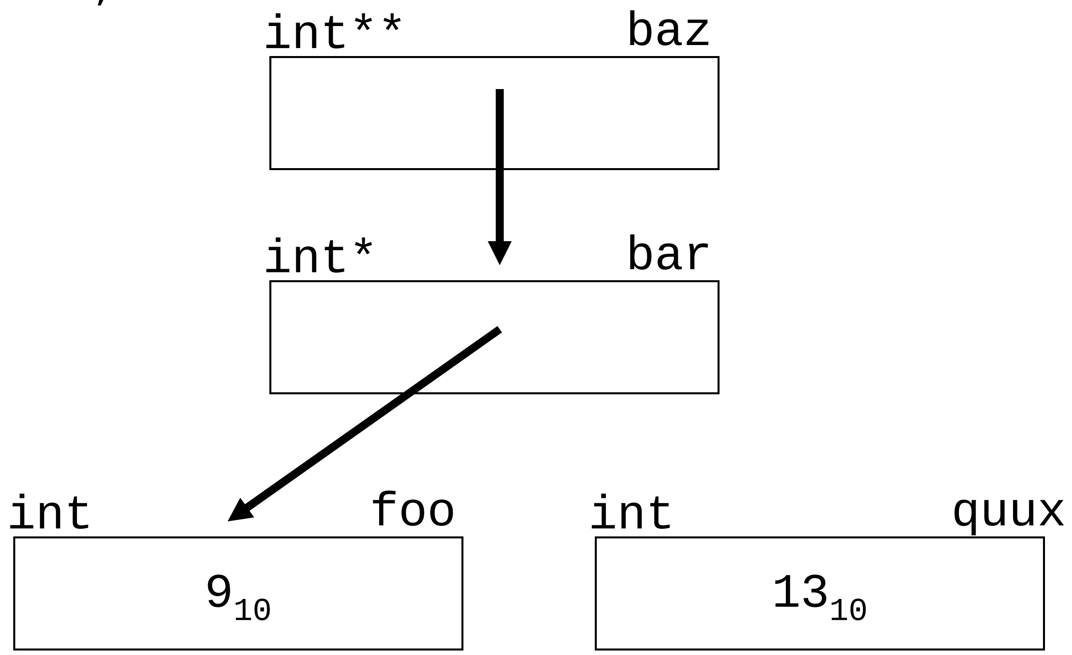

What’s wrong with this program?

```
int modifyCount(int x)
{
  x = x – 1;
}

int main(int argc, char** argv)
{
  int x = 4;
  /* want to change x */
  modifyCount(x);
  return 0;
}
```

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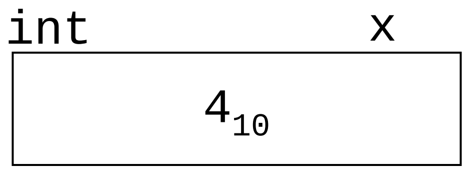

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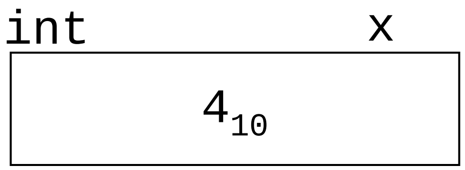

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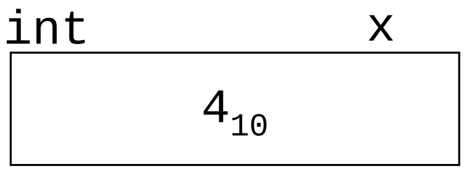

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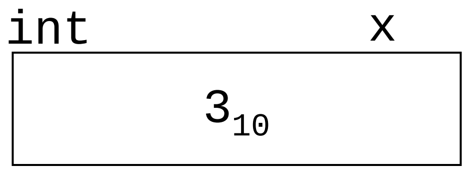

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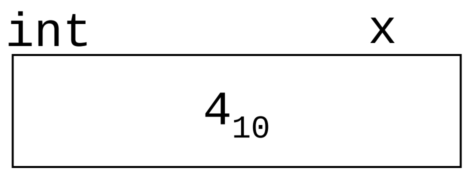
  return 0;
}
```



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{
  x = x – 1;
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int main(int argc, char** argv)
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  /* want to change x */
  modifyCount(x);
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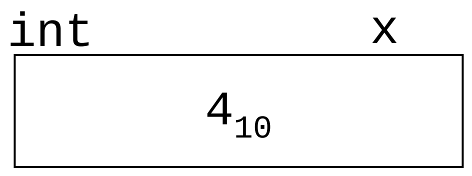

We never changed x! How do we fix this?

Use Pointers!

```
int modifyCount(int* x)
{
  *x = *x - 1;
}

int main(int argc, char** argv)
{
  int x = 4;
  /* want to change x */
  modifyCount(&x);
  return 0;
}
```

What’s wrong with this program?

```
int modifyCount(int* x)
{
  *x = *x – 1;
}
```

```
int main(int argc, char** argv)
{
  int x = 4;
  /* want to change x */
  modifyCount(&x);
  return 0;
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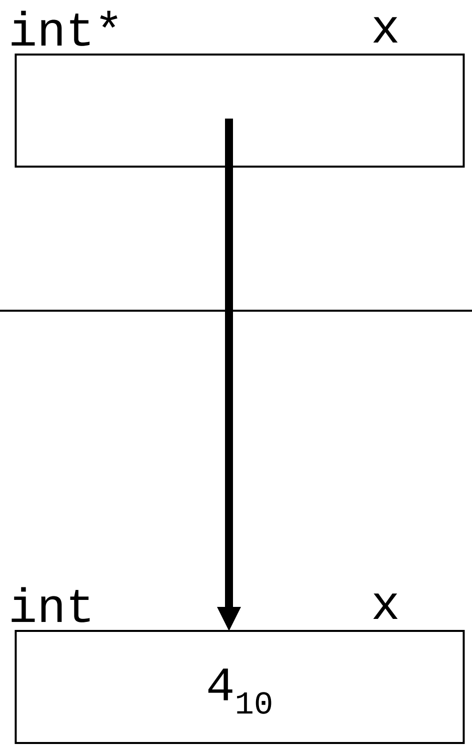

Pointers and ++/- -

Suppose we have the following program:

```
int main(int argc, char** argv)
{
  int i, j;
  int* p = &argc; /* argc = 1 */
  i = (*p)++;
  argc = 1;
  j = ++(*p);
  return 0;
}
```

What is in `i` and `j`?

Pointers and ++/- -

Assuming `x` and `y` have type `int`…

- `y = x++;` is equivalent to `y=x; x=x+1;`
- `y = ++x;` is equivalent to `x=x+1; y=x;`

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```

```
i = *p;
*p = *p + 1;
```

```
*p = *p + 1;
j = *p;
```

What is in `i` and `j`?

i = 1 and j = 2

Pointers and `[]`

- `x[i]` can always be rewritten as `*(x+i)` and vice versa

- Array types can often be converted into their corresponding pointer counterparts
  - `int foo[]` is equivalent to `int* foo`
  - `int* bar[]` is equivalent to `int** bar`
  - You can at most change one set of `[]` safely
    - Changing more requires knowing how the array looks in memory

Pointers and ++/- -

Suppose we have the following program:

```
int main(int argc, char** argv)
{
  int i, j;
  int* p = &argc; /* argc = 1 */
  i = (*p)++;
  argc = 0;
  j = ++(*p);
  return 0;
}
```

```
i = *p;
*p = *p + 1;
```

```
*p = *p + 1;
j = *p;
```

What is in `i` and `j`?

Both contain 1

printf, scanf, and their cousins

- printf (and its cousins) are special functions that do not have a fixed argument list
  - for each format specifier (i.e. %d), an additional argument needs to be supplied
- Examples:
  - `printf(“%d”, 4);`
  - `printf(“%s%d%c”, “CS”, 0x3D, ‘c’);`

printf, scanf, and their cousins

- Unlike printf, with scanf for each format specifier (i.e. %d), an additional argument needs to be supplied that has type pointer

- Examples:
  - `int z; scanf(“%d”, &z);`
  - `char foo[5]; int d;`
    `scanf(“%s %d”, foo, &d);`

C Program Walkthrough

What happens with this program?

```
void quux(int foo)
{
  char a[4];
  char* baz = (char*)(&foo);
  printf("%c%c%c%c",
         baz[0], *(baz + 1), baz[1+1],
         baz[sprintf(a, "123")]);
}

int main(...) {
  quux(0x4d495053);
}
```

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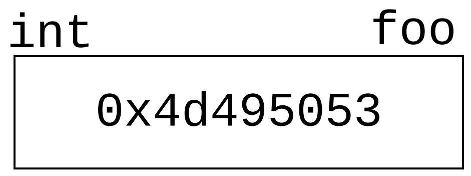

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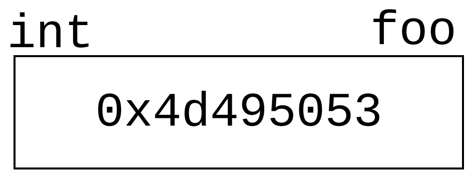

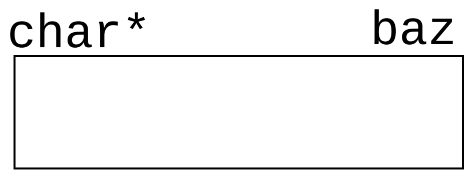

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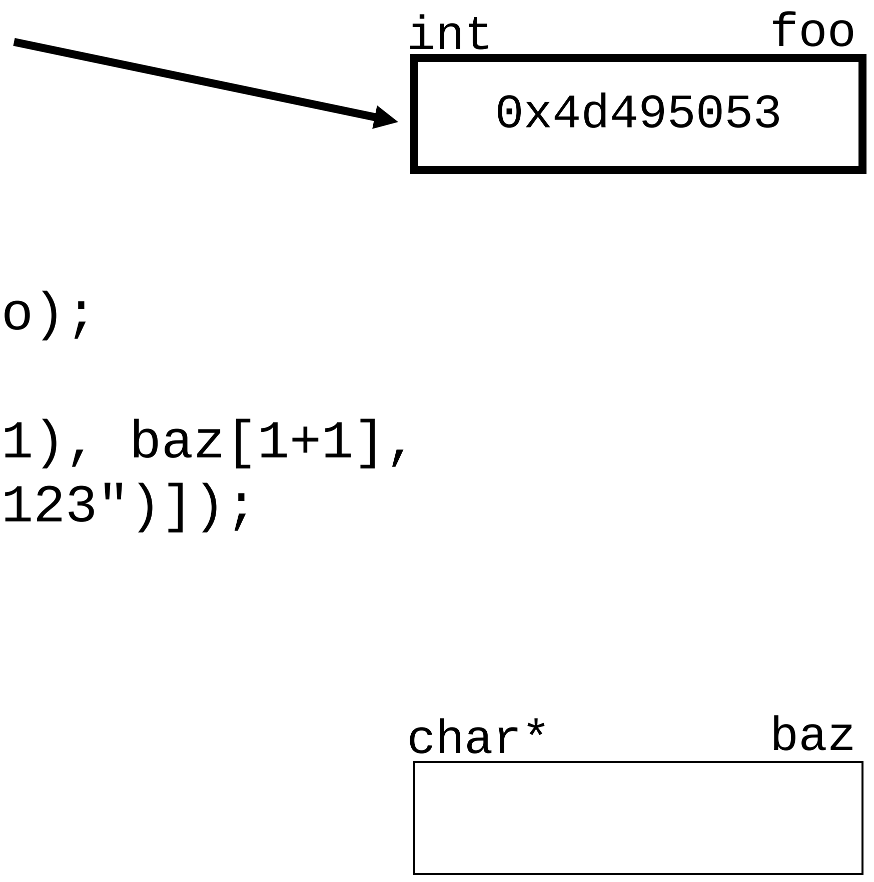

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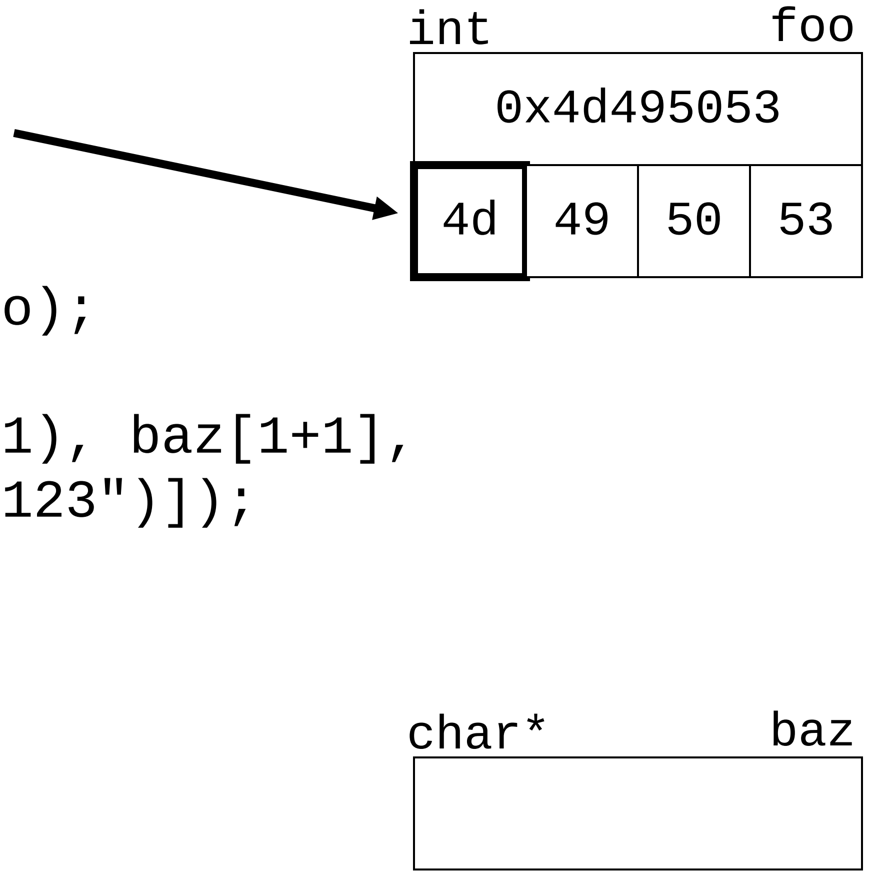

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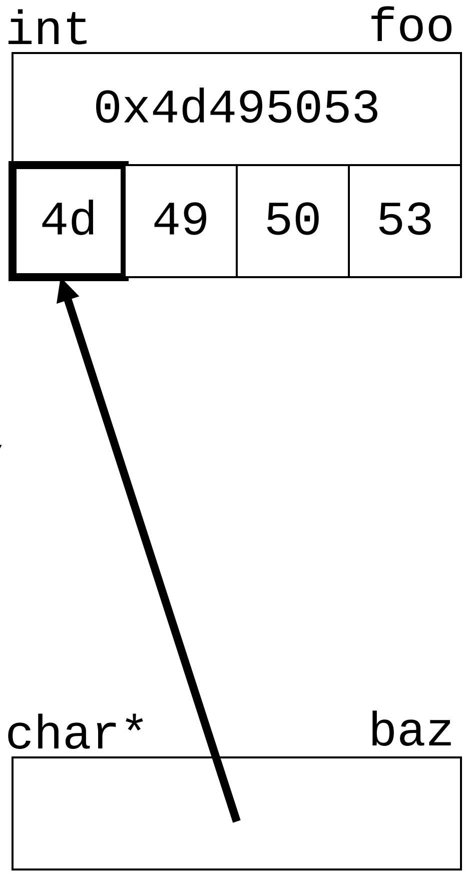

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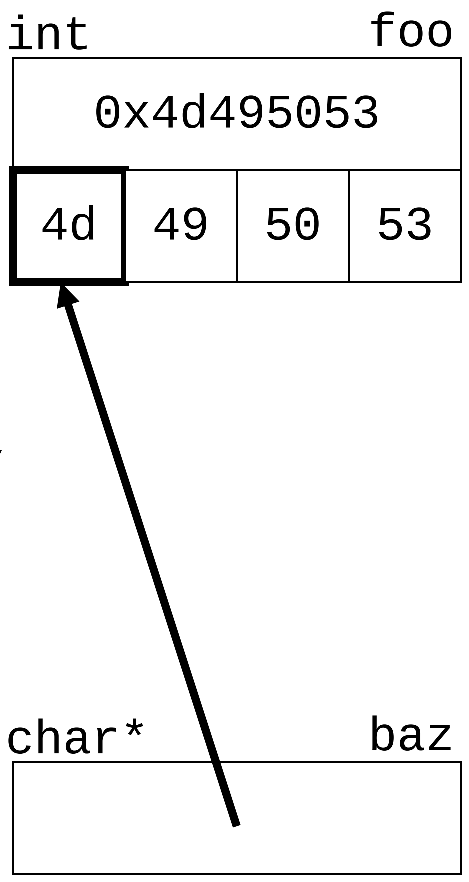

It will print out "MIPS"