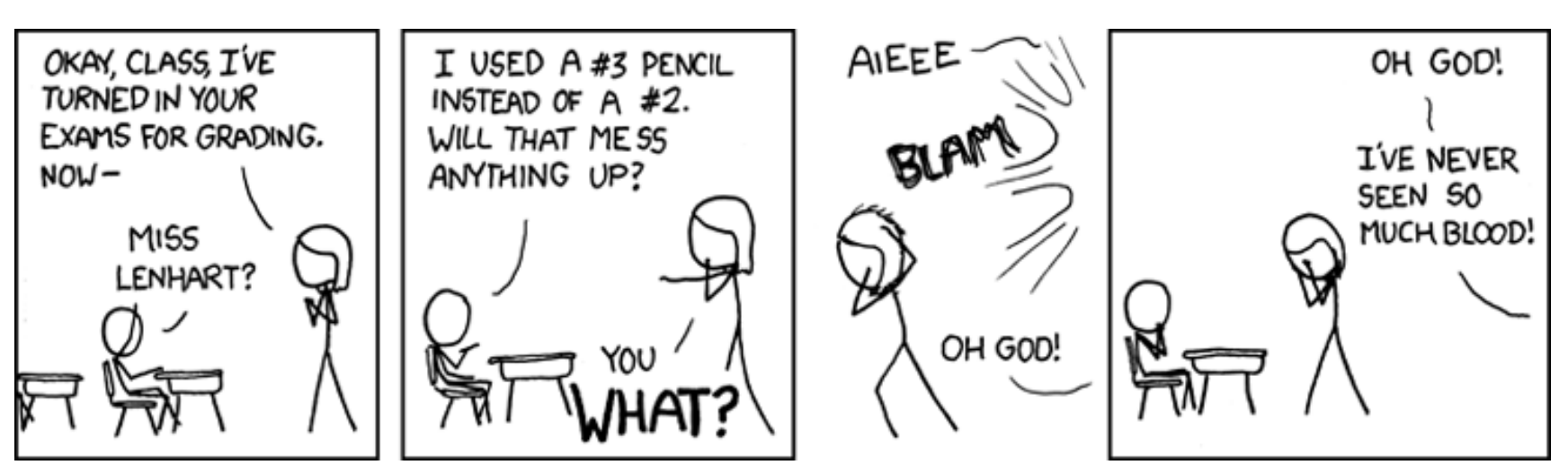
EECS 370 Discussion



xkcd.com

EECS 370 Discussion

Topics Today:

- ARM Addressing
  - Endianness, Loading, and Storing Data
- Data Layout
  - Struct Packing
- Control Flow
  - Branches and PSR (Program Status Register)
- Conditional Assembly
  - Predicated Assembly Instructions
- C to ARM Translation

EECS 370 Discussion

ARM Addressing

EECS 370 Discussion

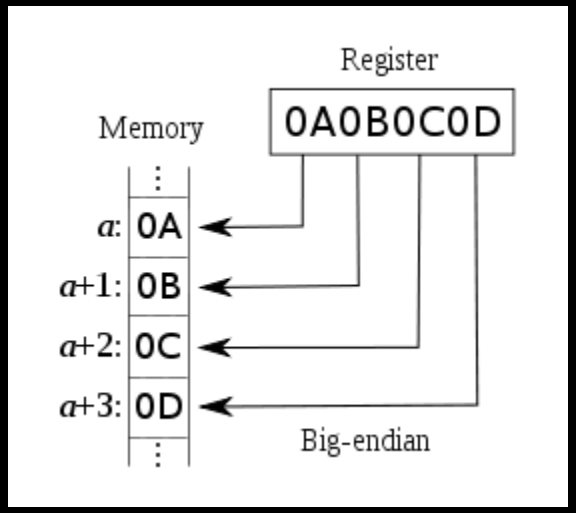
ARM Addressing

Big-Endian means Big End First

- Most Significant Byte (MSB) at first address in memory

In EECS370 we use Big-Endian

Applies to Bytes only!



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ARM Addressing

Example:

```
sub   r1, r1, #0x2
strh  r1, [r2, #0x0]
ldrsb r2, [r2, #0x1]
ldrh  r1, [r0, #0x1002]
```

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Data Layout

Golden Rule

Start address of a variable is aligned based on the variable's type

char – byte aligned

short – halfword aligned

int – word aligned

pointer – word aligned

double – two-word aligned

Structs

- start aligned based on alignment of largest member

- end padded to make overall size a multiple of largest member

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Data Layout

Example:

```
char a;
char* b;
short c;
double* d;
struct {
   int e;
   char f[10];
} g;
```

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Control Flow

ARM Registers:

16 total registers

R0 – R12: General Purpose

R13: Stack Pointer

R14: Link Register

R15: Program Counter ← Dangerous!

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Control Flow

Program Status Register (PSR):

Flags set by various assembly instructions

- N – result is negative
- Z – result is zero
- C – result had a carry out of bit 31
- V – result had an overflow

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Control Flow

Branch Condition Codes based on PSR

eq	EQual	Z == 1
ne	Not Equal	Z == 0
ge	Greater than/Equal	N == V
lt	Less Than	N != V
gt	Greater Than	Z == 0 && N == V
le	Less than/Equal	Z == 1 || N != V
cs	unsigned higher/Same	C == 1
cc	unsigned lower	C == 0
mi	negative	N == 1
pl	positive/Zero	N == 0
vs	oVerflow Set	V == 1
vc	no oVerflow Clear	V == 0
hi	unsigned HIgher	C == 1 && Z == 0
ls	unsigned Lower/Same	C == 0 || Z == 1
al	any/Always	

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Conditional Assembly

Condition Codes can also be applied to other instructions

Example: Translate the following code

```
while (r0 != 0) {
        if (r0 > 0) {
                r0 = r0 – 1;
        } else {
                r0 = r0 + 1;
        }
}
```

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C to ARM Translation

Do some examples.

How to move 32-bit values into registers.