The Datapath
- The datapath consists of the register file and function unit
- The register file has some registers, each with a fixed number of bits
- The function unit consists of circuitry to do calculations
    - Eg adder, shifter, multiplier etc
    - One data out for the result

N = # of bits per word
K = bits required to select a register. Number of register $<= 2^k$
- These can be connected to form a datapath:

drawing

The ALU

- The arithmetic/logic unit part of the function unit
- Our ALU will have 3 select lines:
    - S_2: do a logic (1) or arithmetic (0) operation
    - S_1, S_2: specify the operation

Arithmetic
- The arithmetic circuit is based around an a-bit adder
    - Some extra logic around it will make a very flexible circuit:

drawing

The B input logic will produce these outputs depending on S_1, S_0:

S_1	S_0	Out

0	1	all 0's
0	0	B
1	1	!B
1	0	all 1's

This can be implemented with n of these:

drawing

- The output of the ALU will be

$A + Y + C_{in}$

- That allows these operations:

S_1	S_0	C_{in}	Y	Output
0	0	0	zeros	A transfer
0	0	1	zeros	A +1 Increment
0	1	0	B	A+B add
0	1	1	B	A+B+1 add, inc
1	0	0	!B	A + !B add complement
1	0	1	!B	A+!B +1 A-B subtract
1	1	0	ones	A-1 decrement
1	1	1	ones	a-1+1=A transfer

Bu using the correct combination of these select signals (S_1, S_0, S_2) the ALU can do any of these operations