



Assembler: Source (assembly) program  $\rightarrow$  object file (machine lang).  
(see example code)

A - instructions?

- See if char 0 is '@'
- If the part after @ is digits, convert to binary.

Python: bin Java: Integer.toBinaryString.

Preload symbol table with built-in constants (SCREEN, KBD, 2 passers: 1st pass figures out labels, variables etc. et.)  
2nd pass outputs code.

- 1st pass: build a symbol table + a list of instructions.  
Symbol table maps labels to numbers.

when you see:

(LABEL) : store LABEL  $\rightarrow$  cur instr. # in symbol table.

@ SYMBOL: might be a variable!

if already in the symbol table, ignore.  
otherwise, add to a list.

- For each Symbol in the list:
  - if it is in the symbol table: ignore (it was a label)
  - otherwise, add it to the Symbol table with the next available RAM address.

- 2nd pass:

when we see @ SYMBOL, just look it up in symbol table.  
if we see (LABEL), ignore.  
output bits for instructions.