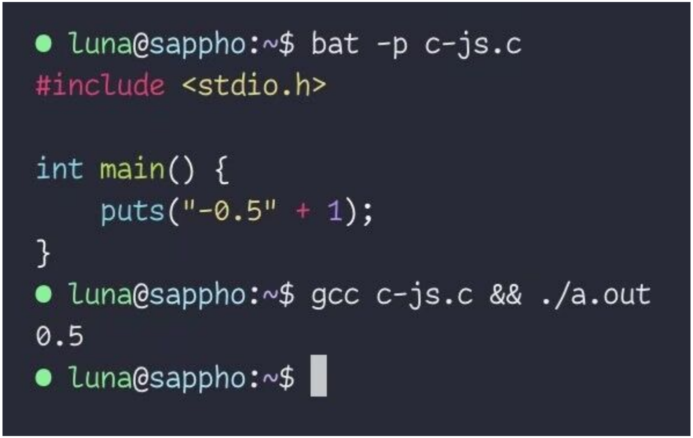
CS100 Recitation 5

Who? GKxx

When? March 21, 2022

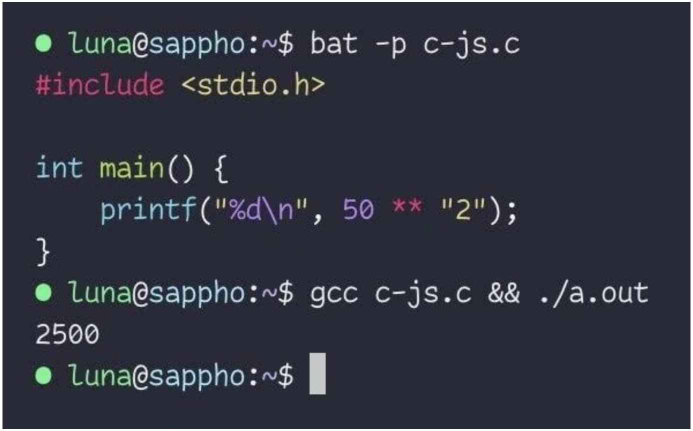
Warmup



```
● luna@sappho:~$ bat -p c-js.c
#include <stdio.h>

int main() {
    puts("-0.5" + 1);
}
● luna@sappho:~$ gcc c-js.c && ./a.out
0.5
● luna@sappho:~$ 
```

Warmup



```
● luna@sappho:~$ bat -p c-js.c
#include <stdio.h>

int main() {
    printf("%d\n", 50 ** "2");
}
● luna@sappho:~$ gcc c-js.c && ./a.out
2500
● luna@sappho:~$ 
```

Contents

Streams

Definition (Stream)

A stream is a sequence of characters read from or written to an IO device.

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Standard input and output streams: `stdin` and `stdout`.

- `scanf`, `gets`, `getchar`: read from `stdin`.
- `printf`, `puts`, `putchar`: write to `stdout`.

By default, `stdin` and `stdout` are directed to the console.

Redirection

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- The online grader redirects your program and compares the output file with the answer file.

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- Example: `./program < test.in > test.out`
- The online grader redirects your program and compares the output file with the answer file.
- Input from any file terminates with `EOF`!
  - `EOF` is a special character with ASCII value -1.
  - It is suggested to use `int` to store the return-value of `getchar`, why?

Redirection

Use `freopen` to redirect:

```
int main() {
  freopen("in_file.txt", "r", stdin);
  freopen("out_file.txt", "w", stdout);
  // ...
}
```

Redirection

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  freopen("out_file.txt", "w", stdout);
  // ...
}
```

- stdin and stdout are redirected to "input_file.txt" and "output_file.txt" respectively.
- "r": read; "w": write;
- There are also some other open modes.

File IO Functions

```c
int main() {
  FILE *in = fopen("in_file.txt", "r");
  FILE *out = fopen("out_file.txt", "w");
  int a, b;
  fscanf(in, "%d%d", &a, &b);
  fprintf(out, "%d\n", a + b);
  printf("%d\n", a + b);
  fclose(in);
  fclose(out);
  return 0;
}
```

- FILE: a special type storing the information of a file.
- `fscanf`, `fprintf`, `fgets`, `fputs`, `fgetc`, `fputc`.
- Use `fopen` and `fclose`.

String IO Functions

- sscanf: read data in an “scanf-way” from a string.
- sprintf: write data in a “printf-way” to a string.

```
// roundabout way, just for demostration
int main() {
  char str[100];
  gets(str);
  int a, b;
  sscanf(str, "%d%d", &a, &b);
  char result[100];
  sprintf(result, "%d", a + b);
  puts(result);
  return 0;
}
```

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struct Tile {
  int num;
  char kind;
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- We can define a variable of such type:

```c
struct Tile t;
```

- Use member-access operator:

```c
t.num = 1;
t.kind = 's';
printf("%d\n", t.num);
```

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An unnamed structure (which cannot be used after definition):

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Defining both a structure and a variable (**not suggested coding-style**):

```
struct Tile {
  int num;
  char kind;
} t;
```

Use typedef

```
typedef long long LL;
```

Use typedef, so that we don't need the struct keyword everytime we use it.

```
typedef struct {
  int num;
  char type;
} Tile;
```

Use typedef

Within the typedef declaration, you cannot refer to the type alia.

```
typedef struct {
  int value;
  Node *next;   // Error
} Node;
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  Node *next;    // Error
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```

Correct way: Give it a name first.

```
typedef struct _node_ {
  int value;
  struct _node_ *next;
} Node;
```

Incomplete Type

You cannot define a member of the type itself:

```
struct Widget {
  struct Widget w;
  int x;
};
```

- In syntax: during the definition, the type '`struct Widget`' is an incomplete type. It is not allowed to define a variable of an incomplete type.
- In semantics: What's the size of a '`struct Widget`'?

Memory Alignment

```c
typedef struct {
  int num;
  char kind;
} Tile;
```

```c
sizeof(Tile) != sizeof(int) + sizeof(char)
```

- In most implementations, the structure above takes 8 bytes. The storage will be aligned to multiple of 4.

Initialization

- Default initialization of a structure initializes every member by default (with an undefined value).
- Value initialization of a structure initializes every member by value-initialization (with all types of '0').

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- Default initialization of a structure initializes every member by default (with an undefined value).
- Value initialization of a structure initializes every member by value-initialization (with all types of ‘0’).
- Copy initialization: `Tile a = b;` copies the value of each member of `b` to `a`.
  - `b` must be of type `Tile`.

Copy-assignment

```
Tile a, b;
a.num = 1; a.kind = 's';
b = a;
```

The assignment operator is generated by the compiler, which copies the value of each member of RHS to LHS.

A Unique Type

Every structure is a unique type.

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```
typedef struct {
  int num;
  char kind;
} Fake_tile;
Fake_tile ft;
ft = a;                  // Error
Fake_tile ft2 = a;   // Error
```

`Fake_tile` and `Tile` are different types, even though their definitions look the same.

Parameter and Return-value

```c
Tile next_tile(Tile t) {
  Tile next;
  next.num = t.num + 1;
  next.kind = t.kind;
  return next;
}
```

Parameter and Return-value

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Tile next_tile(Tile t) {
  Tile next;
  next.num = t.num + 1;
  next.kind = t.kind;
  return next;
}
```

- When passing as an argument, it is in fact **copy-initializing** the parameter `Tile t`.
- When `returning` from a function, it is in fact **copy-initializing** the temporary object generated by the calling expression. (In C, and before C++11)

Parameter and Return-value

How many copies are there?

```
Tile next_tile(Tile t) {
  Tile next = t;
  ++t.num;
  return next;
}
int main() {
  Tile tile;
  tile.num = 1;
  tile.kind = 's';
  Tile tile2 = next_tile(tile);
  return 0;
}
```

Parameter and Return-value

```
Tile next_tile(Tile t) {
  Tile next = t;
  ++t.num;
  return next;
}
// in main
Tile tile, tile2;
tile.num = 1; tile.kind = 's';
tile2 = next_tile(tile);
```

- copy-initialization of parameter `t`.
- copy-initialization of `next`;
- copy-initialization of a temporary object generated by `next_tile(tile)`, with the value `return`ed.
- copy-assignment to `tile2`.

Dynamic Allocation

`malloc` and `free` as usual.

```
Tile *thetile
  = (Tile *)malloc(sizeof(Tile));
Tile *manytiles
  = (Tile *)malloc(sizeof(Tile) * n);
free(thetile); free(manytiles);
```

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```

Access through pointers: dereference, and then access.

```
*thetile.num = 1;    // Error!
(*thetile).num = 1; // Correct
thetile->num = 1;    // Preferred
```

Remark

The member-access operator has **higher** precedence than the dereference operator.