Computer Labs: Lab 5 & Sprites

2º MIEIC

Pedro F. Souto (pfs@fe.up.pt)

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The “Class” Sprite: `sprite.h` (by jcard@fe.up.pt)

Sprite “Two-dimensional image that is integrated into a larger scene” (Wikipedia)

- Allows the integration of independent pixmaps into a scene
- Allows image animation without altering the background – thus a sprite can be considered an overlay image

```
typedef struct {
    int x, y; // current position
    int width, height;  // dimensions
    int xspeed, yspeed; // current speed
    char *map;          // the pixmap
} Sprite;
```

The pixmap uses **black** (or some unused color) for the background, which is assumed to be transparent

The “Class” Sprite: `sprite.c`

```
/** Creates a new sprite with pixmap "pic", with specified
 *  position (within the screen limits) and speed;
 * Does not draw the sprite on the screen
 * Returns NULL on invalid pixmap.
 */
Sprite *create_sprite(const char *pic[], int x, int y,
                      int xspeed, int yspeed) {
    //allocate space for the "object"
    Sprite *sp = (Sprite *) malloc ( sizeof(Sprite));
    xpm_image_t img;
    if( sp == NULL )
        return NULL;
    // read the sprite pixmap
    sp->map = xpm_load(pic, XPM_INDEXED, &img);
    if( sp->map == NULL ) {
        free(sp);
        return NULL;
    }
    sp->width = img.width; sp->height=img.height;
    ...
    return sp;
}
```

The “Class” Sprite: `sprite.c`

```
void destroy_sprite(Sprite *sp) {
    if( sp == NULL )
        return;
    if( sp ->map )
        free(sp->map);
    free(sp);
    sp = NULL;      // XXX: pointer is passed by value
                    //            should do this @ the caller
}

int animate_sprite(Sprite *sp) {
    ...
}

/* Some useful non-visible functions */
static int draw_sprite(Sprite *sp, char *base) {
    ...
}
static int check_collision(Sprite *sp, char *base) {
    ...
}
```

Lab 5: `test_move()`

```
int video_test_move( const char *xpm[],,
                     uint16_t xi, uint16_t yi,
                     uint16_t xf, uint16_t yf
                     int8_t speed, uint8_t frame_rate)
```

What? Move a sprite on the screen (only along the x or y axes)

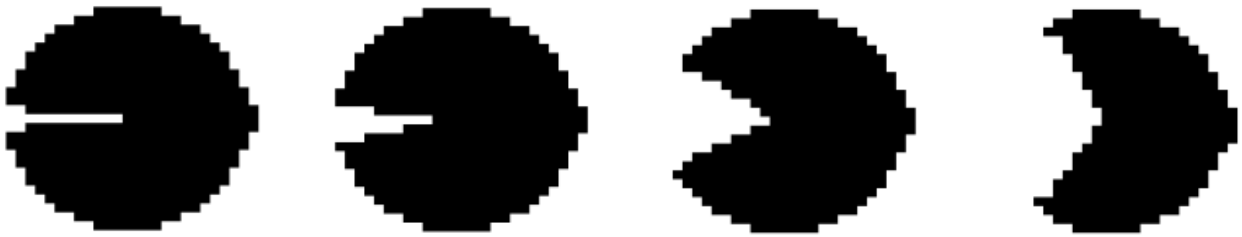
- `xpm` XPM for the sprite
- `(xi,yi)` initial coordinates (of ULC)
- `(xf,yf)` final coordinates (of ULC)
- `speed` speed
  - **If non-negative** number of pixels between consecutive frames
  - **If negative** number of frames required for a 1 pixel movement
- `frame_rate` number of frames per second

How? Should use the `sprite` "class"

- But you can change it slightly (I did).
- Need not implement all functions.

Sprite Animation

- Animation of a sprite can be achieved by presenting a sequence of pixmaps
  - Each pixmap (but the first) in this sequence differs slightly from the previous pixmap



- To create an animated sprite we need to specify several pixmaps
  - This can be done in different ways
- We'll use a C function with a variable number of arguments:

```
AnimSprite *create_animSprite(uint8_t no_pic, char *pic1[],
```

`printf()` is the most common C function of this type

(Functions with a Variable Number of Arguments (1/2))

- Must have at least one argument
  - The type of each argument may also vary between calls
- But, needs to know
  - How many arguments in the list
  - The type of each of these arguments
- Uses a kind of an iterator, of type `va_list`, to traverse the list of variable arguments
- Relies on a set of macros defined in `<stdarg.h>`, whose first parameter is the "iterator":

  `va_start` to initialize the iterator to the first argument of the list
  - The second argument is the last known argument

  `va_arg` to get the next argument of the list (and step to the next)
  - The second argument is the type of that argument
  - On first invocation, returns the first argument after the last known argument

  `va_end` to finalize the access

(Functions with a Variable Number of Arguments (2/2))

```
#include <stdarg.h> // va_* macros are defined here
int foo(int required, ...) {
    va_list ap; // "pointer" to next argument
    va_start(ap, required); // initializes ap to point to
        // first argument of the list ;
        // the 2nd argument is the last fixed function argument
    int i = va_arg(ap, int); // accesses the next list argument
        // the second argument of va_arg() is the type
        // on first call, returns the value of the first
        // argument after the  last fixed  argument
    float i = va_arg(ap, float);
    char *s = va_arg(ap, char *);
    va_end(ap); // must be called to finalize the access
}
```

The “Class” Animated Sprite: `AnimSprite.h`

```
#include <stdarg.h> // va_* macros are defined here
#include "sprite.h"
typedef struct {
    Sprite *sp;      // standard sprite
    int aspeed;      // no. frames per pixmap
    int cur_aspeed; // no. frames left to next change
    int num_fig;     // number of pixmaps
    int cur_fig;     // current pixmap
    char **map;      // array of pointers to pixmaps
} AnimSprite;

AnimSprite(uint8_t no_pic, char *pic1[], ...);
int animate_animSprite(AnimSprite *sp,);
void destroy_animSprite(AnimSprite *sp);
```

Animation speed is measured as number of “frames” per pixmap

The “Class” Animated Sprite: `AnimSprite.c` (1/2)

```
AnimSprite *create_animSprite(uint8_t no_pic,
                              char *pic1[], ...) {
    AnimSprite *asp = malloc(sizeof(AnimSprite));
    // create a standard sprite with first pixmap
    asp->sp = create_sprite(pic1,0,0,0,0);
    // allocate array of pointers to pixmaps
    asp->map = malloc((no_pic) * sizeof(char *));
    // initialize the first pixmap
    asp->map[0] = asp->sp->map;
    // continues in next transparency
```

The “Class” Animated Sprite: `AnimSprite.c` (2/2)

```
// initialize the remainder with the variable arguments
// iterate over the list of arguments
va_list ap;
va_start(ap, pic1);
for( i = 1; i <no_pic; i++ ) {
    char **tmp = va_arg(ap, char **);
    xpm_image_t img;
    asp->map[i] = xpm_load(tmp, XPM_INDEXED, &img);
    if( asp->map[i] == NULL
        || img.width != asp->sp->width || img.height != asp-
        // failure: realease allocated memory
        for(j = 1; j<i;j ++)
            free(asp->map[i]);
        free(asp->map);
        destroy_sprite(asp->sp);
        free(asp);
        va_end(ap);
        return NULL;
    }
}
va_end(ap);
...
```

Thanks to:

Based on material by:

- João Cardoso (jcard@fe.up.pt)

Further Reading

- João Cardoso, Notas sobre *Sprites*