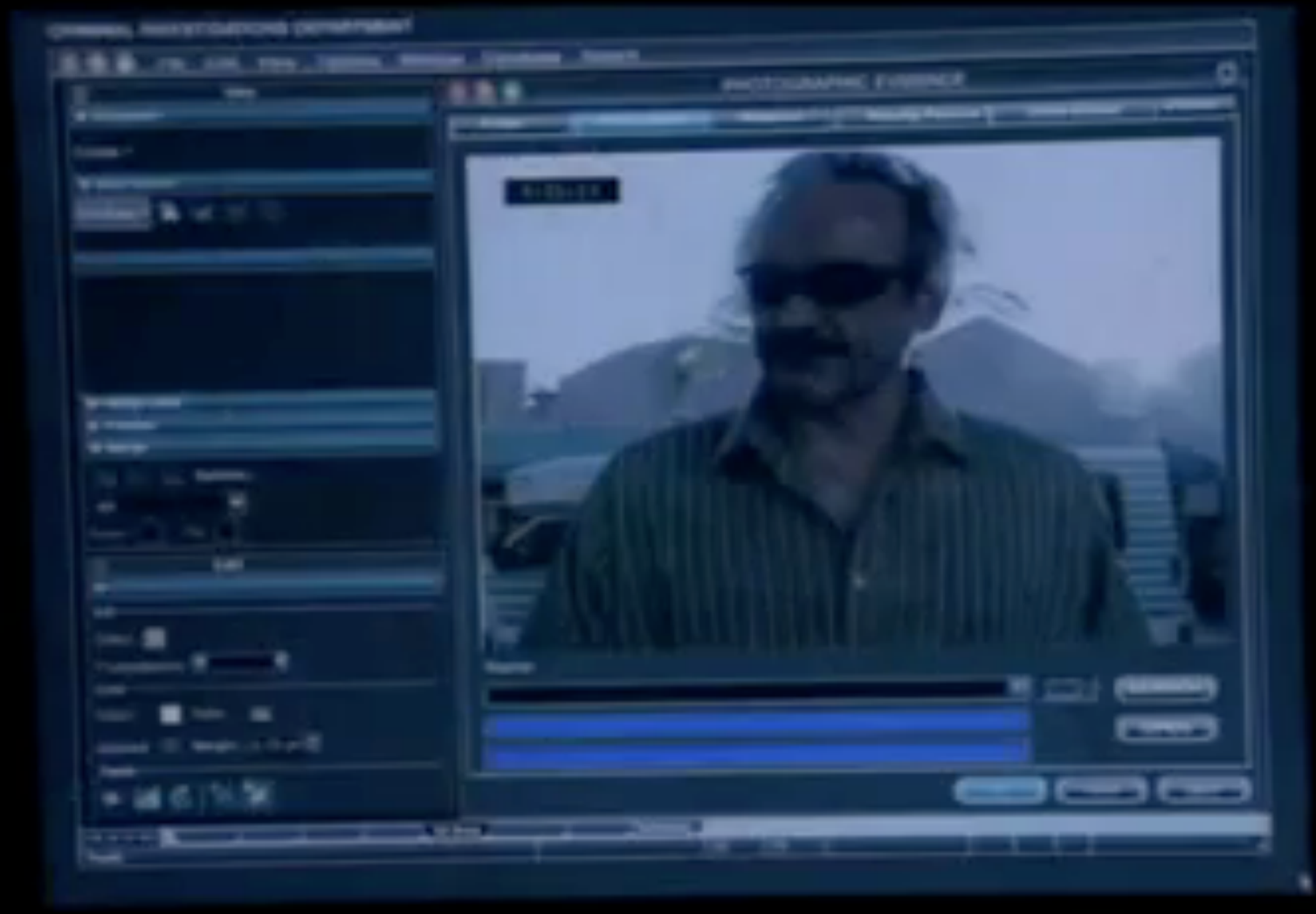



POINTER
FUN

```
int main(void)
{
    int* x;
    int* y;

    x = malloc(sizeof(int));

    *x = 42;

    *y = 13;

    y = x;

    *y = 13;
}
```

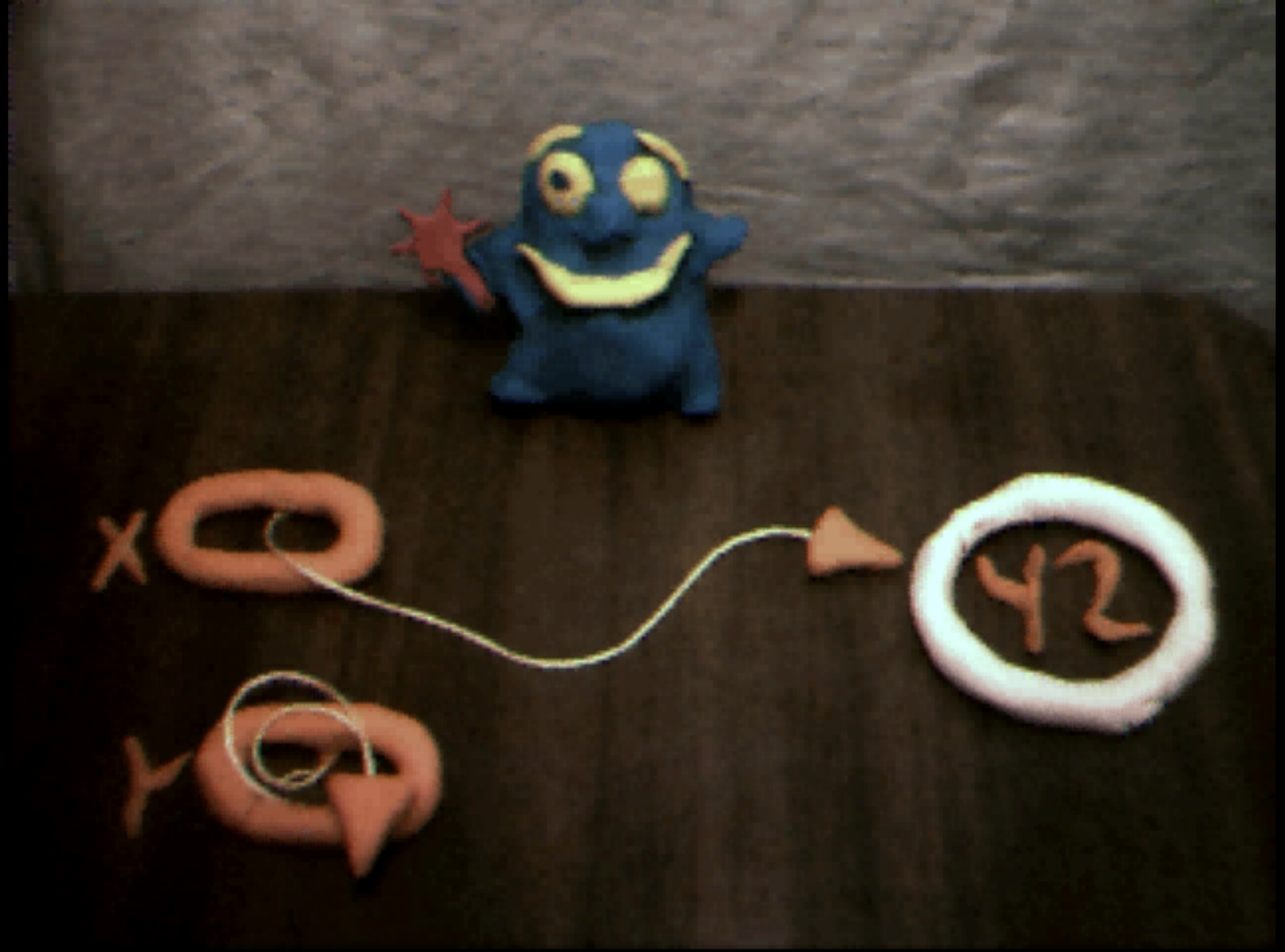
```
int* x;
int* y;
```


```
int* x;
int* y;
```

```
x = malloc(sizeof(int));
```

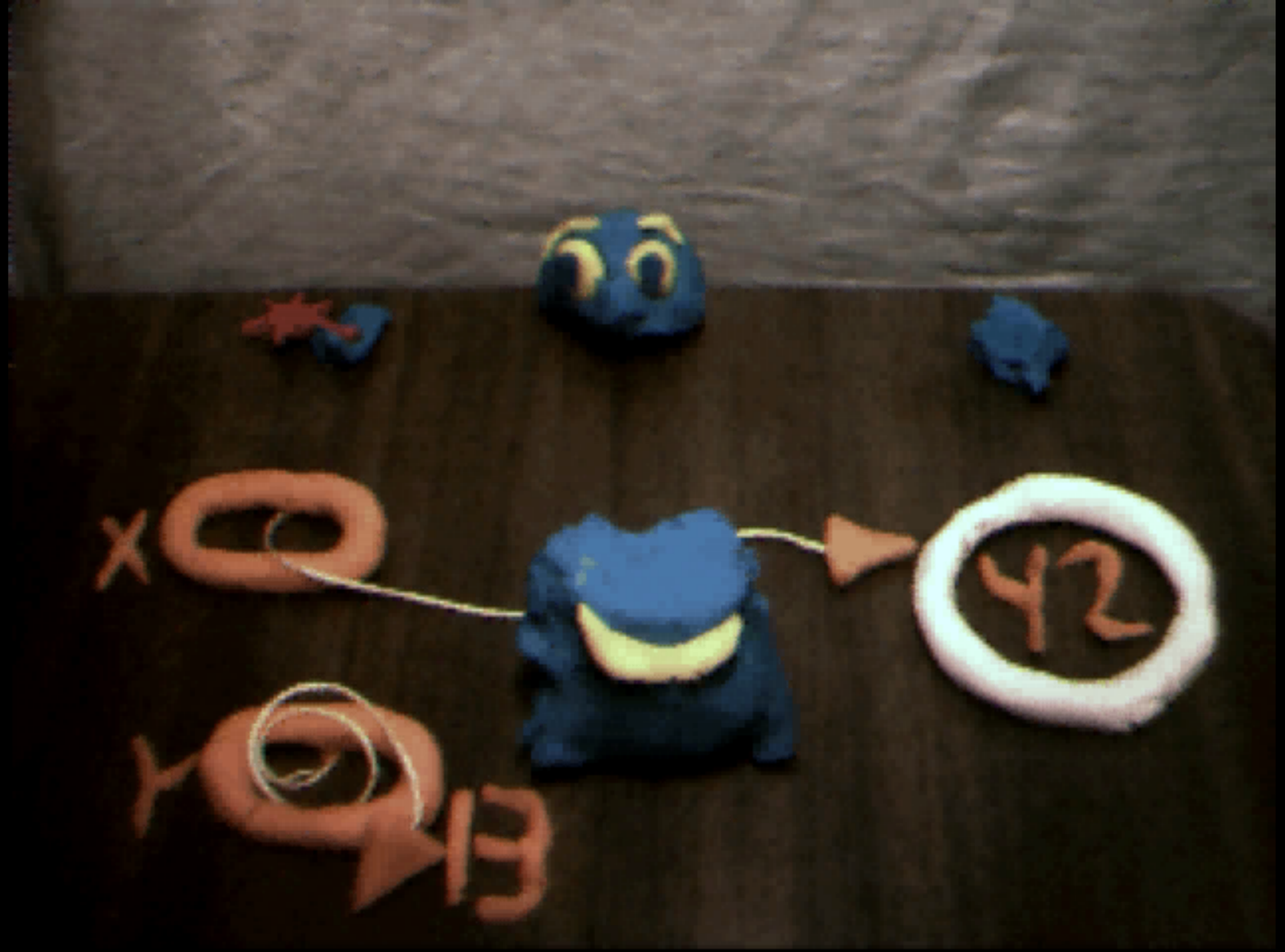

```
x = malloc(sizeof(int));
```

```
*x = 42;
```



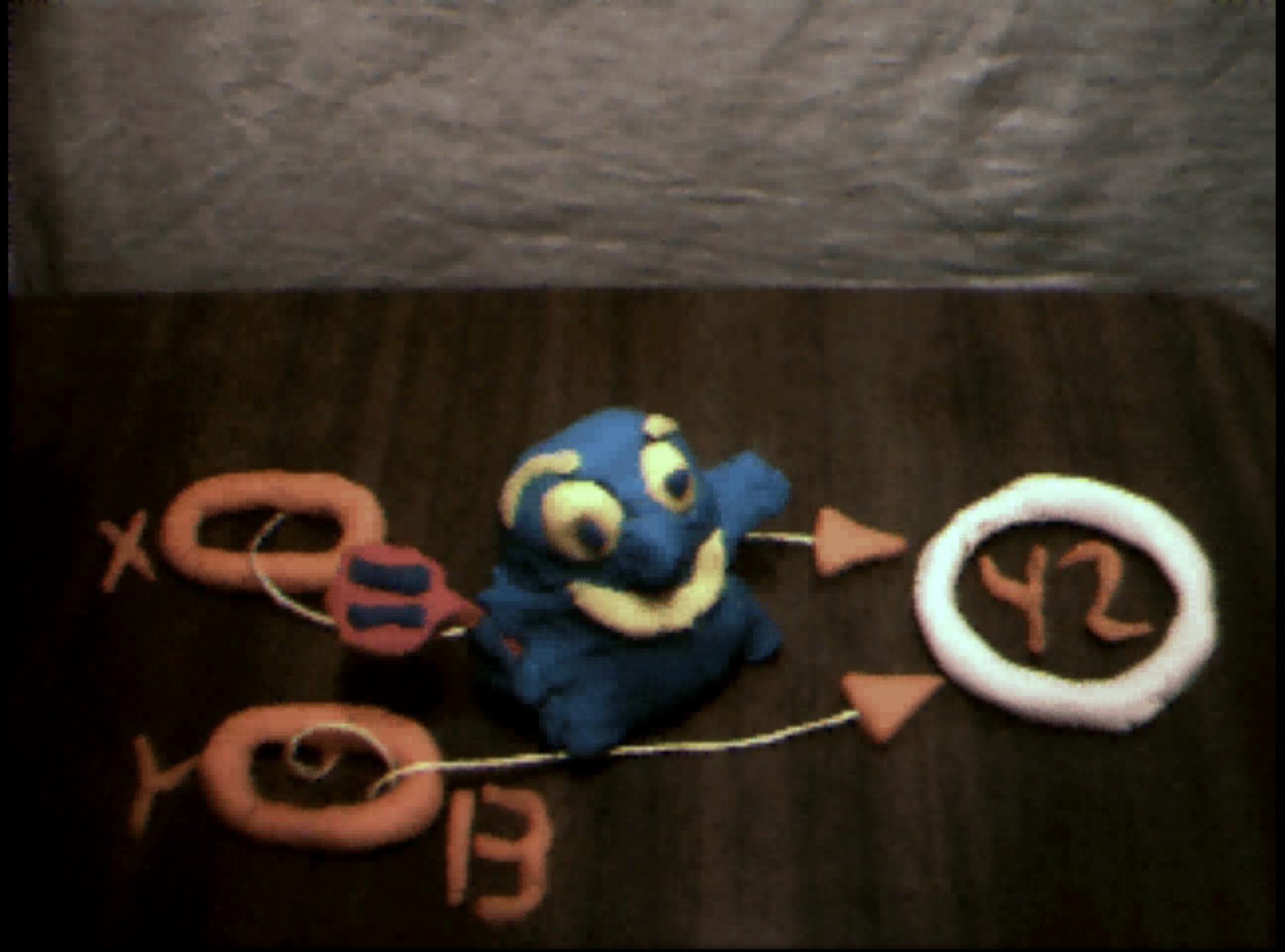

```
*x = 42;
```

```
*y = 13;
```



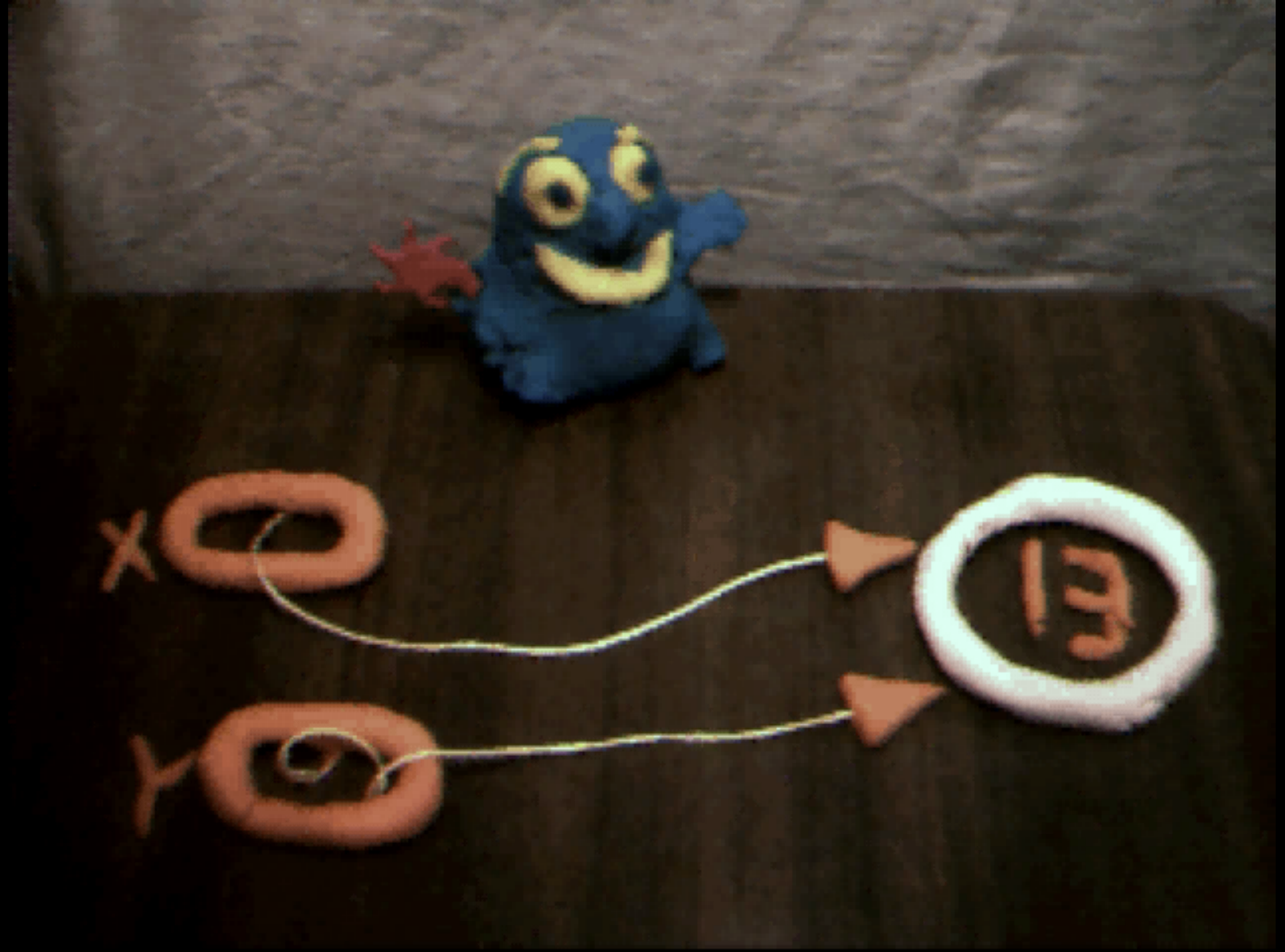

```
*y = 13;
```

```
y = x;
```




```
y = x;
```

```
*y = 13;
```




```
*y = 13;
```

CS50 Library

```
GetChar

GetDouble

GetFloat

GetInt

GetLongLong

GetString
```

memory leak

valgrind

valgrind --leak-check=full ./program

```
Invalid write of size 4
   at 0x4005FF: f (memory.c:21)
   by 0x400623: main (memory.c:26)

...

40 bytes in 1 blocks are definitely lost in loss record 1 of 1
   at 0x4C2AB80: malloc (in /usr/lib/valgrind/vgpreload_memcheck-amd64-linux.so)
   by 0x4005F6: f (memory.c:20)
   by 0x400623: main (memory.c:26)
```

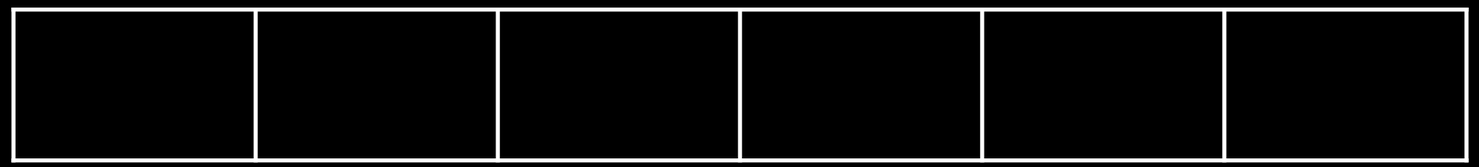
valgrind

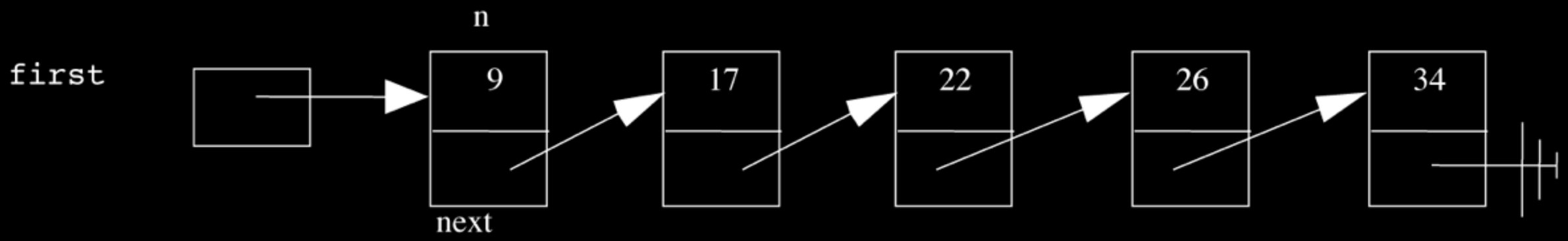
```
valgrind --leak-check=full ./program
```

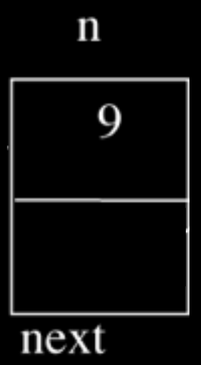
```
Invalid write of size 4
   at 0x4005FF: f (memory.c:21)
   by 0x400623: main (memory.c:26)

...

40 bytes in 1 blocks are definitely lost in loss record 1 of 1
   at 0x4C2AB80: malloc (in /usr/lib/valgrind/vgpreload_memcheck-amd64-linux.so)
   by 0x4005F6: f (memory.c:20)
   by 0x400623: main (memory.c:26)
```

http://xkcd.com/138/

arrays




n
first
9
17
22
26
34
next

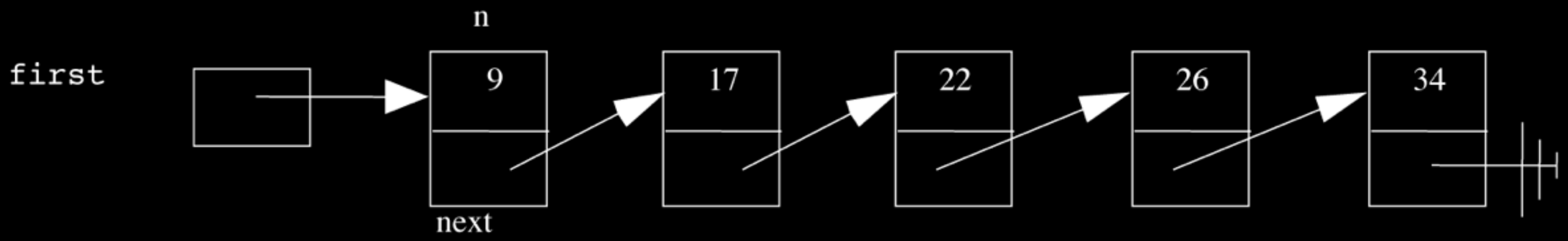

n
9
next

```
typedef struct
{
    string name;
    string house;
}
student;
```

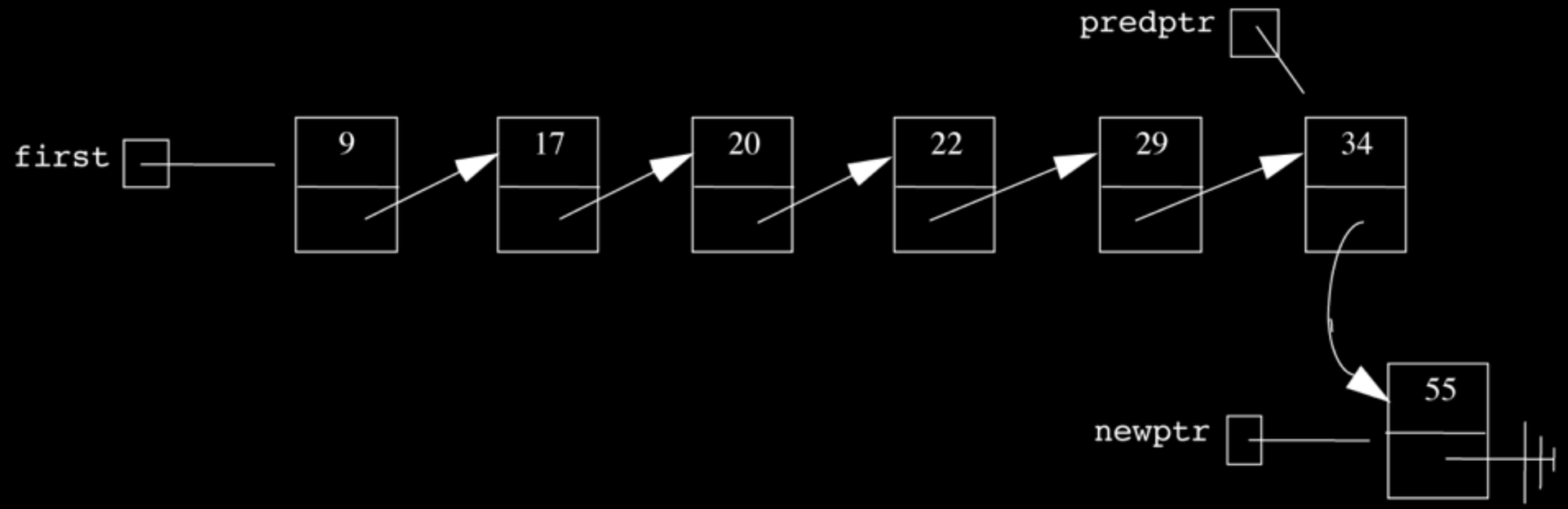
```
typedef struct node
{
    int n;
    struct node* next;
}
node;
```

```
typedef struct node
{
    int n;
    struct node* next;
}
node;
```

```
typedef struct node
{
    int n;
    struct node* next;
}
node;
```

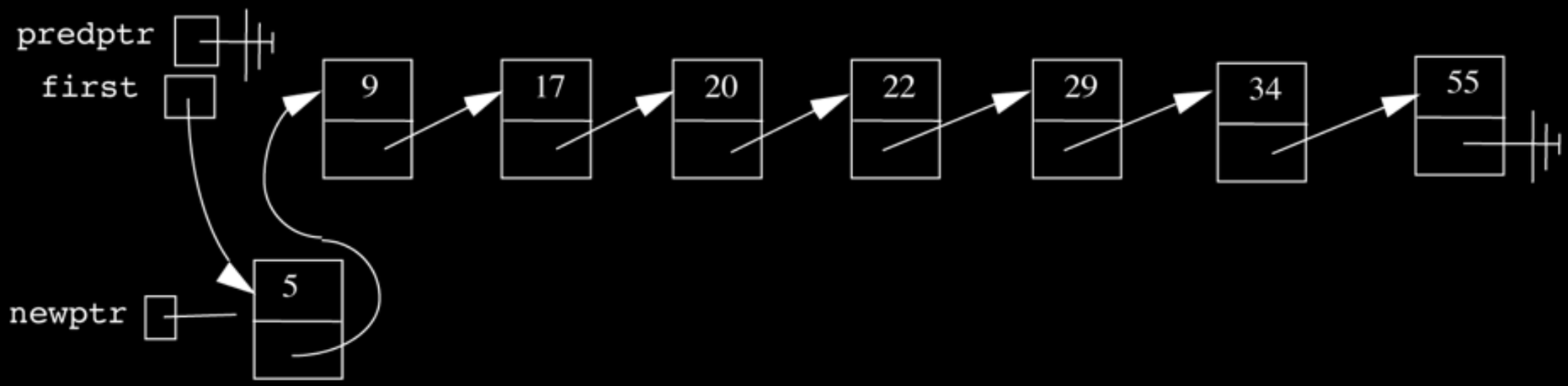

n
first
9
17
22
26
34
next

insert at tail



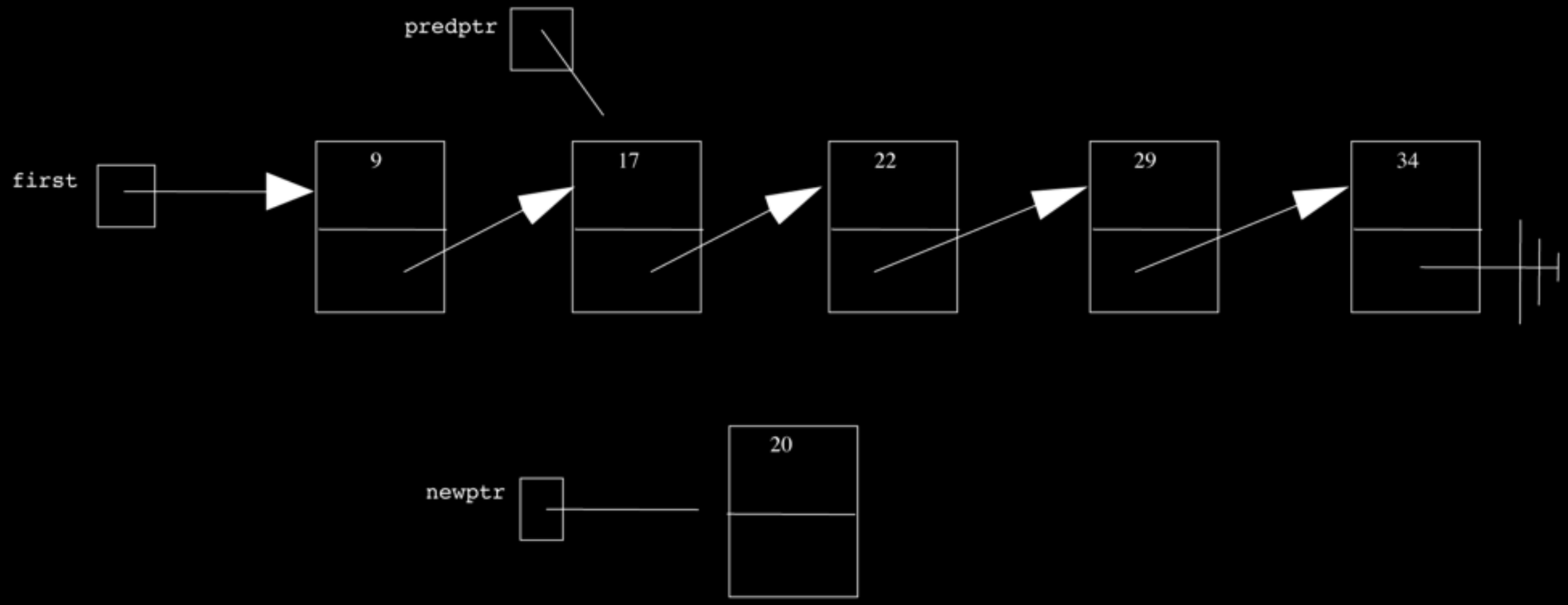
http://cs.calvin.edu/books/c++/ds/1e/

insert at head



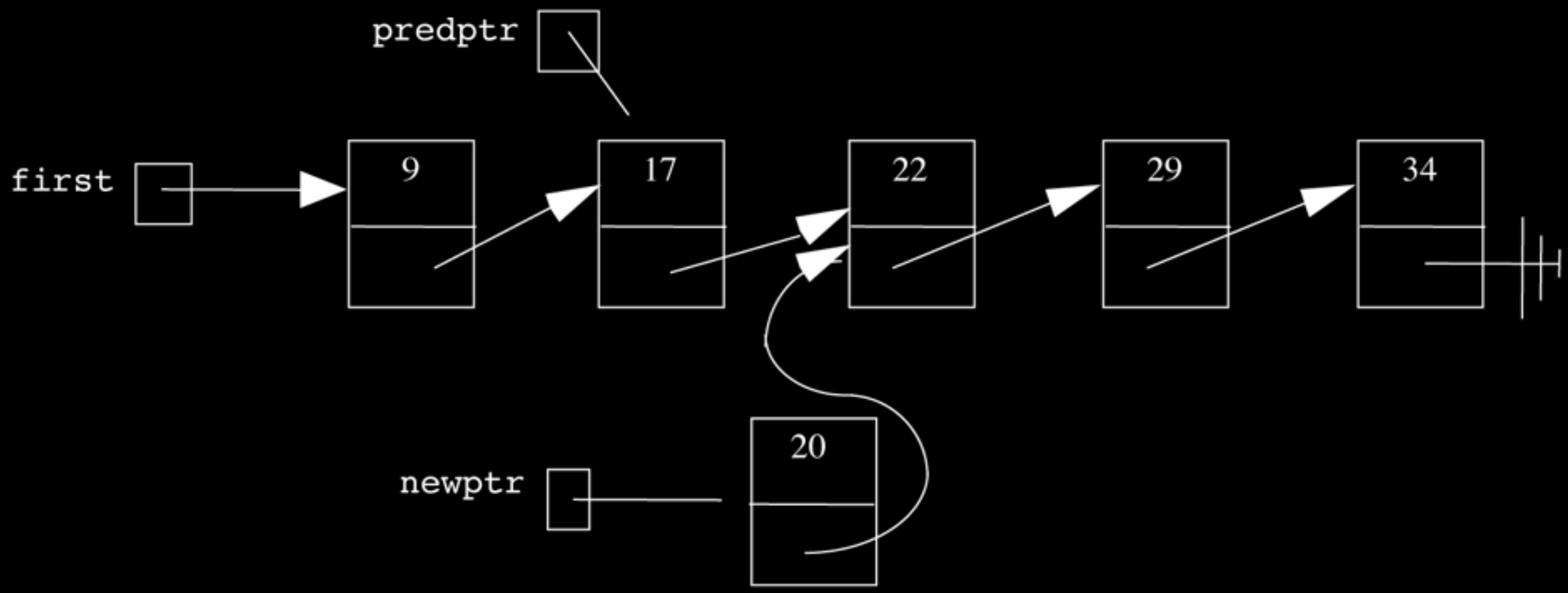
http://cs.calvin.edu/books/c++/ds/1e/

insert in middle



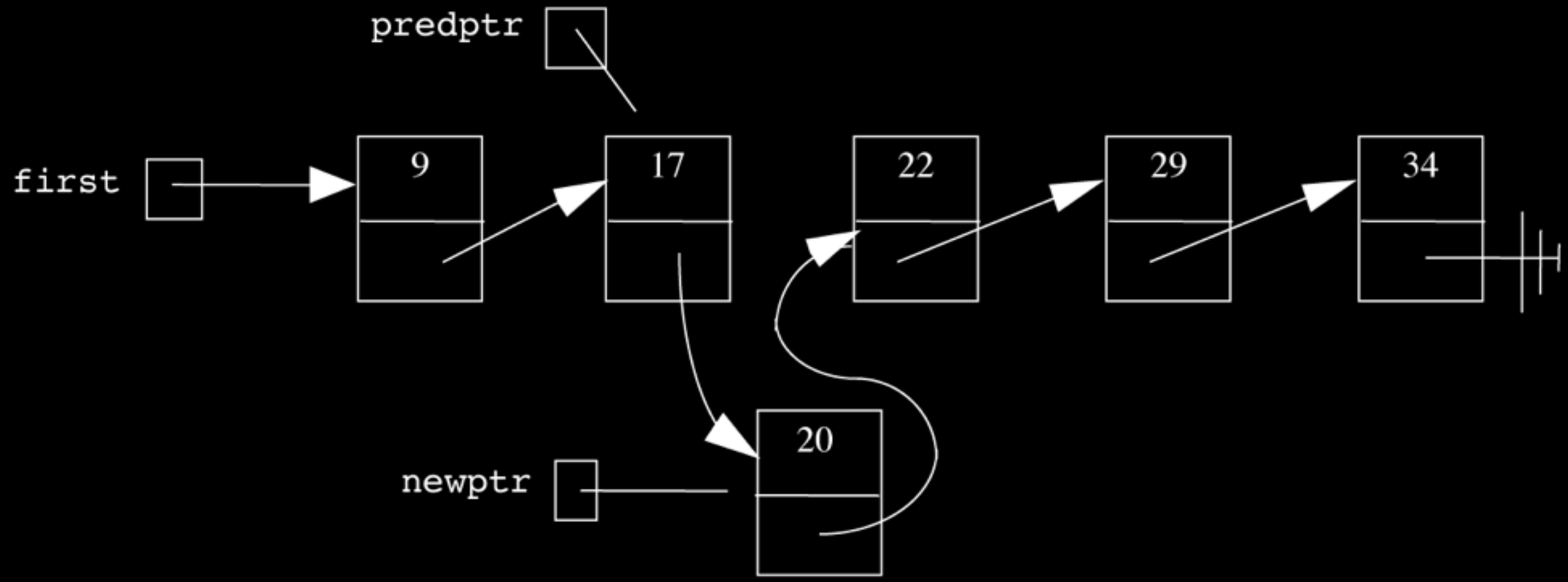
http://cs.calvin.edu/books/c++/ds/1e/

insert in middle



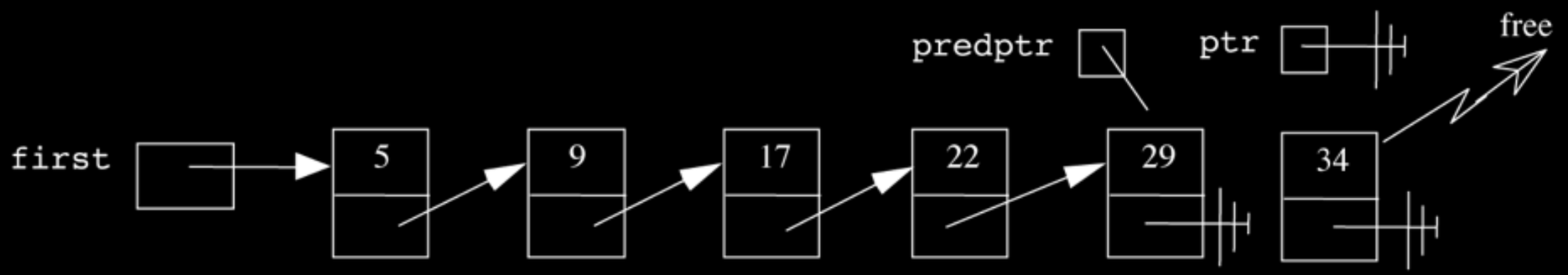
http://cs.calvin.edu/books/c++/ds/1e/

insert in middle



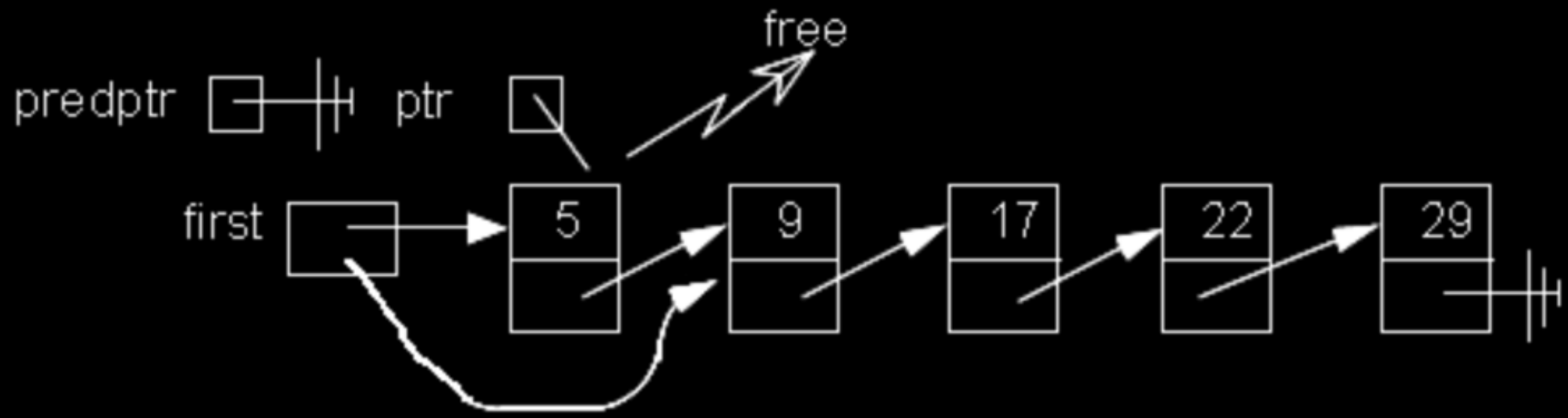
http://cs.calvin.edu/books/c++/ds/1e/

remove tail



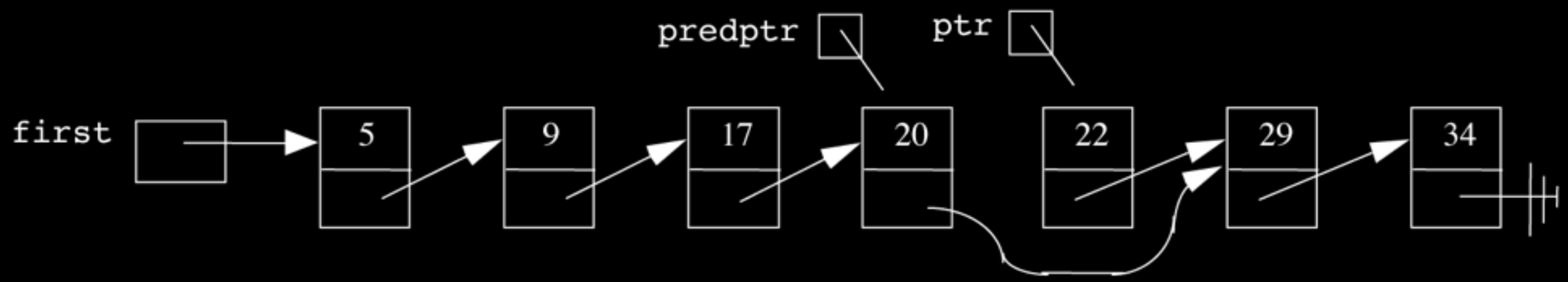
http://cs.calvin.edu/books/c++/ds/1e/

remove head



http://cs.calvin.edu/books/c++/ds/1e/

remove in middle



http://cs.calvin.edu/books/c++/ds/1e/


THANKS FOR YOUR

o

$O(\log n)$

$O(1)$