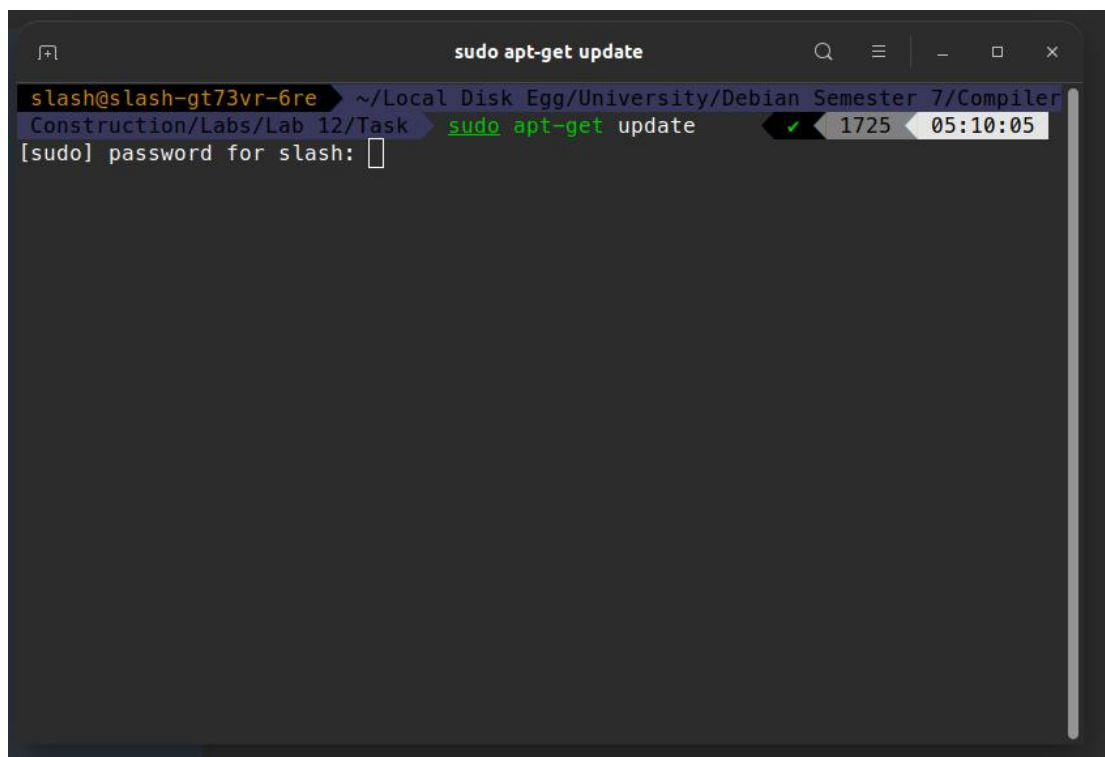


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Class: BSCS-8-A
CMS: 242554

Compiler Construction Lab 12

Task 1 (Install LLVM):

- Installing LLVM using apt-get, first update apt-get.



```
slash@slash-gt73vr-6re ~/Local Disk Egg/University/Debian Semester 7/Compiler Construction/Labs/Lab 12/Task$ sudo apt-get update
[sudo] password for slash: 
```

- Installing LLVM with command “ *sudo apt-get -y install llvm* ”

```
sudo apt-get -y install llvm
slash@slash-gt73vr-6re ~/Local Disk Egg/University/Debian Semester 7/Compiler
Construction/Labs/Lab 12/Task sudo apt-get -y install llvm
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  binfmt-support libclang-cpp10 libffi-dev libpfm4 libz3-4 libz3-dev llvm-10
  llvm-10-dev llvm-10-runtime llvm-10-tools llvm-runtime python3-pygments
Suggested packages:
  llvm-10-doc python-pygments-doc ttf-bitstream-vera
The following NEW packages will be installed:
  binfmt-support libclang-cpp10 libffi-dev libpfm4 libz3-4 libz3-dev llvm
  llvm-10 llvm-10-dev llvm-10-runtime llvm-10-tools llvm-runtime
  python3-pygments
0 upgraded, 13 newly installed, 0 to remove and 49 not upgraded.
Need to get 49.5 MB of archives.
After this operation, 301 MB of additional disk space will be used.
Get:1 http://us.archive.ubuntu.com/ubuntu focal/universe amd64 binfmt-support am
d64 2.2.0-2 [58.2 kB]
Get:2 http://us.archive.ubuntu.com/ubuntu focal/universe amd64 libclang-cpp10 am
d64 1:10.0.0-4ubuntu1 [9,944 kB]
10% [2 libclang-cpp10 5,034 kB/9,944 kB 51%] 849 kB/s 52s
```

- Checking if installed by “`apt-cache policy llvm`”

```
slash@slash-gt73vr-6re:~/Local Disk Egg/University/Debian Semester 7/...
slash@slash-gt73vr-6re ~/Local Disk Egg/University/Debian Semester 7/Compiler
Construction/Labs/Lab 12/Task apt-cache policy llvm
llvm:
  Installed: 1:10.0-50~exp1
  Candidate: 1:10.0-50~exp1
  Version table:
 *** 1:10.0-50~exp1 500
      500 http://us.archive.ubuntu.com/ubuntu focal/universe amd64 Packages
      100 /var/lib/dpkg/status
slash@slash-gt73vr-6re ~/Local Disk Egg/University/Debian Semester 7/Compiler
Construction/Labs/Lab 12/Task [✓] 1728 05:18:39
```

NOTE: NO NEED TO CONFIGURE AND COMPILE AS APT-INSTALLED

- Installing clang12 as not exists:

```
sudo apt install clang-12 --install-suggests

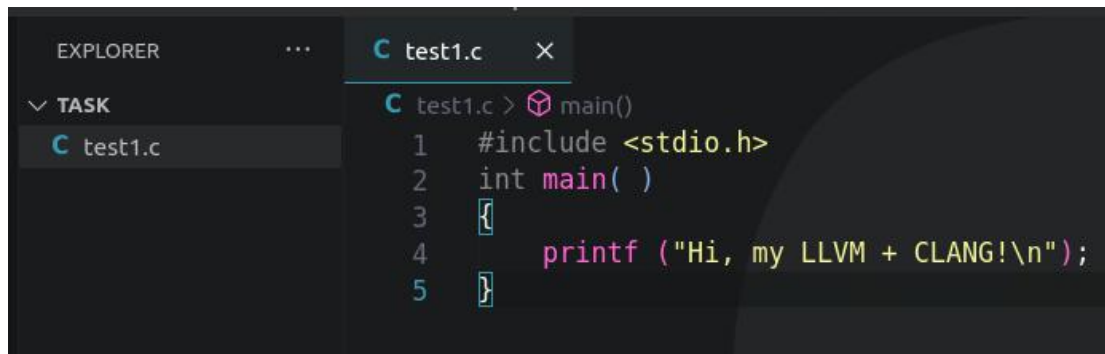
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  clang-12-doc fonts-font-awesome fonts-lato fonts-mathjax
  fonts-mathjax-extras fonts-stix javascript-common lib32gcc-s1 lib32stdc++6
  libc6-i386 libclang-common-12-dev libclang-cpp12 libclang1-12 libgc1c2
  libjs-jquery libjs-mathjax libjs-mathjax-doc libjs-modernizr libjs-sphinxdoc
  libjs-underscore libobjc9-dev libobjc4 libomp-12-dev libomp-12-doc
  libomp5-12 llvm-12 llvm-12-dev llvm-12-doc llvm-12-linker-tools
  llvm-12-runtime llvm-12-tools sphinx-rtd-theme-common
The following NEW packages will be installed:
  clang-12 clang-12-doc fonts-font-awesome fonts-lato fonts-mathjax
  fonts-mathjax-extras fonts-stix javascript-common lib32gcc-s1 lib32stdc++6
  libc6-i386 libclang-common-12-dev libclang-cpp12 libclang1-12 libgc1c2
  libjs-jquery libjs-mathjax libjs-mathjax-doc libjs-modernizr libjs-sphinxdoc
  libjs-underscore libobjc9-dev libobjc4 libomp-12-dev libomp-12-doc
  libomp5-12 llvm-12 llvm-12-dev llvm-12-doc llvm-12-linker-tools
  llvm-12-runtime llvm-12-tools sphinx-rtd-theme-common
0 upgraded, 33 newly installed, 0 to remove and 49 not upgraded.
Need to get 85.7 MB of archives.
After this operation, 571 MB of additional disk space will be used.
Do you want to continue? [Y/n]
```

- Check if installed:

```
clang-12 --version
Ubuntu clang version 12.0.0-3ubuntu1~20.04.4
Target: x86_64-pc-linux-gnu
Thread model: posix
InstalledDir: /usr/bin
```

Task 2 (LLVM Code):

- Created “ task1.c “ with code given:




```
EXPLORER  ...  C test1.c  X

TASK
C test1.c

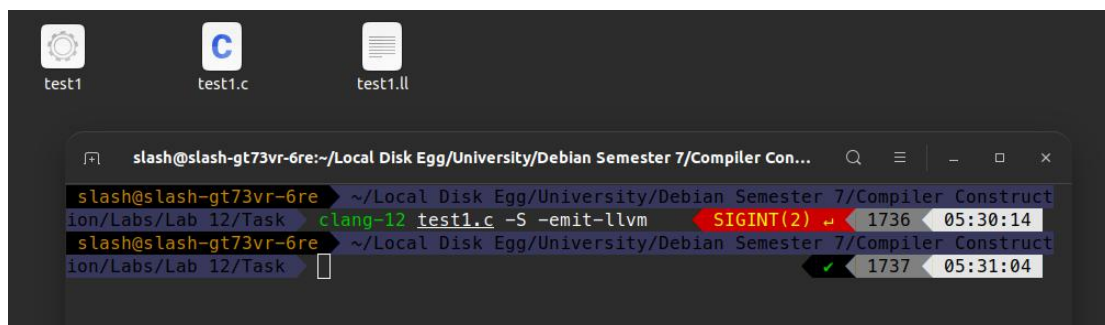
C test1.c > main()
1  #include <stdio.h>
2  int main( )
3  {
4      printf ("Hi, my LLVM + CLANG!\n");
5  }
```

- **Compiling using clang (native code) and running it:**



```
slash@slash-gt73vr-6re:~/Local Disk Egg/University/Debian Semester 7/Compiler Construct
ion/Labs/Lab 12/Task > clang-12 -o test1 test1.c  SIGINT(2) 1734 05:27:42
slash@slash-gt73vr-6re:~/Local Disk Egg/University/Debian Semester 7/Compiler Construct
ion/Labs/Lab 12/Task > ./test1  1735 05:27:43
Hi, my LLVM + CLANG!
slash@slash-gt73vr-6re:~/Local Disk Egg/University/Debian Semester 7/Compiler Construct
ion/Labs/Lab 12/Task >  1736 05:27:46
```

- **Generate LLVM IR (Assembly Form) using following command:**



```
slash@slash-gt73vr-6re:~/Local Disk Egg/University/Debian Semester 7/Compiler Construct
ion/Labs/Lab 12/Task > clang-12 test1.c -S -emit-llvm  SIGINT(2) 1736 05:30:14
slash@slash-gt73vr-6re:~/Local Disk Egg/University/Debian Semester 7/Compiler Construct
ion/Labs/Lab 12/Task >  1737 05:31:04
```



```
test1.ll
~/Local Disk Egg/University/Debian Semester 7/Compiler Construction/Labs/Lab 12/Task

1; ModuleID = 'test1.c'
2 source_filename = "test1.c"
3 target datalayout = "e-m:e-p270:32:32-p271:32:32-p272:64:64-i64:64-f80:128-n8:16:32:64-S128"
4 target triple = "x86_64-pc-linux-gnu"
5
6 @.str = private unnamed_addr constant [22 x i8] c"Hi, my LLVM + CLANG!\0A\00", align 1
7
8 ; Function Attrs: noinline nounwind optnone uwtable
9 define dso_local i32 @main() #0 {
10     %1 = call i32 @__printf(i8*, ...) @printf(i8* getelementptr inbounds ([22 x i8], [22 x i8]* @.str, i64 0, i64 0))
11     ret i32 0
12 }
13
14 declare dso_local i32 @__printf(i8*, ...) #1
15
16 attributes #0 = { noinline nounwind optnone uwtable "disable-tail-calls"="false" "frame-pointer"="all" "less-precise-fpmad"="false" "min-legal-vector-width"="0" "no-infs-fp-math"="false" "no-jump-tables"="false" "no-nans-fp-math"="false" "no-signed-zeros-fp-math"="false" "no-trapping-math"="true" "stack-protector-buffer-size"="8" "target-cpu"="x86-64" "target-features"="+cx8,+fxsr,+mmx,+sse,+sse2,+x87" "tune-cpu"="generic" "unsafe-fp-math"="false" "use-soft-float"="false" }
17 attributes #1 = { "disable-tail-calls"="false" "frame-pointer"="all" "less-precise-fpmad"="false" "no-infs-fp-math"="false" "no-nans-fp-math"="false" "no-signed-zeros-fp-math"="false" "no-trapping-math"="true" "stack-protector-buffer-size"="8" "target-cpu"="x86-64" "target-features"="+cx8,+fxsr,+mmx,+sse,+sse2,+x87" "tune-cpu"="generic" "unsafe-fp-math"="false" "use-soft-float"="false" }
18
19 !llvm.module.flags = !{!0}
20 !llvm.ident = !{!1}
21
22 !0 = !{i32 1, !"wchar_size", i32 4}
23 !1 = !{!"Ubuntu clang version 12.0.0-3ubuntu1-20.04.4"}
```

● Running same command with optimization flag:

```
test1
test1.c
test1.ll

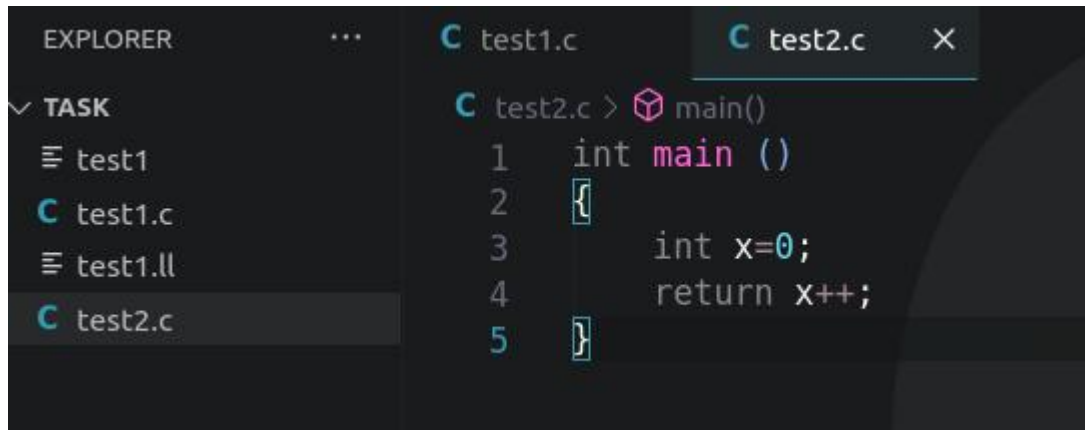
slash@slash-gt73vr-6re:~/Local Disk Egg/University/Debian Semester 7/Compiler Construction/Labs/Lab 12/Task
$ clang-12 test1.c -S -emit-llvm -O3
$ clang-12 test1.c -S -emit-llvm -O3
1738 05:33:36
```

```
test1.ll
~/Local Disk Egg/University/Debian Semester 7/Compiler Construction/Labs/Lab 12/Task

1; ModuleID = 'test1.c'
2 source_filename = "test1.c"
3 target datalayout = "e-m:e-p270:32:32-p271:32:32-p272:64:64-i64:64-f80:128-n8:16:32:64-S128"
4 target triple = "x86_64-pc-linux-gnu"
5
6 @.str = private unnamed_addr constant [21 x i8] c"Hi, my LLVM + CLANG!\0", align 1
7
8 ; Function Attrs: nofree nounwind uwtable
9 define dso_local i32 @main() local_unnamed_addr #0 {
10     %1 = tail call i32 @__puts(i8* nonnull dereferenceable(1) getelementptr inbounds ([21 x i8], [21 x i8]* @.str, i64 0, i64 0))
11     ret i32 0
12 }
13
14 ; Function Attrs: nofree nounwind
15 declare noundef i32 @__puts(i8* nocapture noundef readonly) local_unnamed_addr #1
16
17 attributes #0 = { nofree nounwind uwtable "disable-tail-calls"="false" "frame-pointer"="none" "less-precise-fpmad"="false" "min-legal-vector-width"="0" "no-infs-fp-math"="false" "no-jump-tables"="false" "no-nans-fp-math"="false" "no-signed-zeros-fp-math"="false" "no-trapping-math"="true" "stack-protector-buffer-size"="8" "target-cpu"="x86-64" "target-features"="+cx8,+fxsr,+mmx,+sse,+sse2,+x87" "tune-cpu"="generic" "unsafe-fp-math"="false" "use-soft-float"="false" }
18 attributes #1 = { nofree nounwind }
19
20 !llvm.module.flags = !{!0}
21 !llvm.ident = !{!1}
22
23 !0 = !{i32 1, !"wchar_size", i32 4}
24 !1 = !{!"Ubuntu clang version 12.0.0-3ubuntu1-20.04.4"}
```

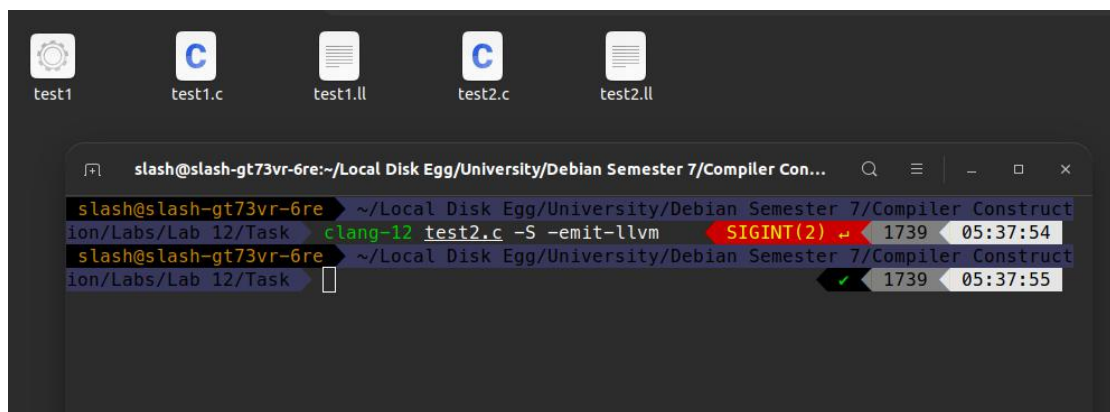
Difference : Optimized code have some other functions used like “Puts” in place of “print” , etc. In [DSOLOCAL](#)

- Doint the same for another code:



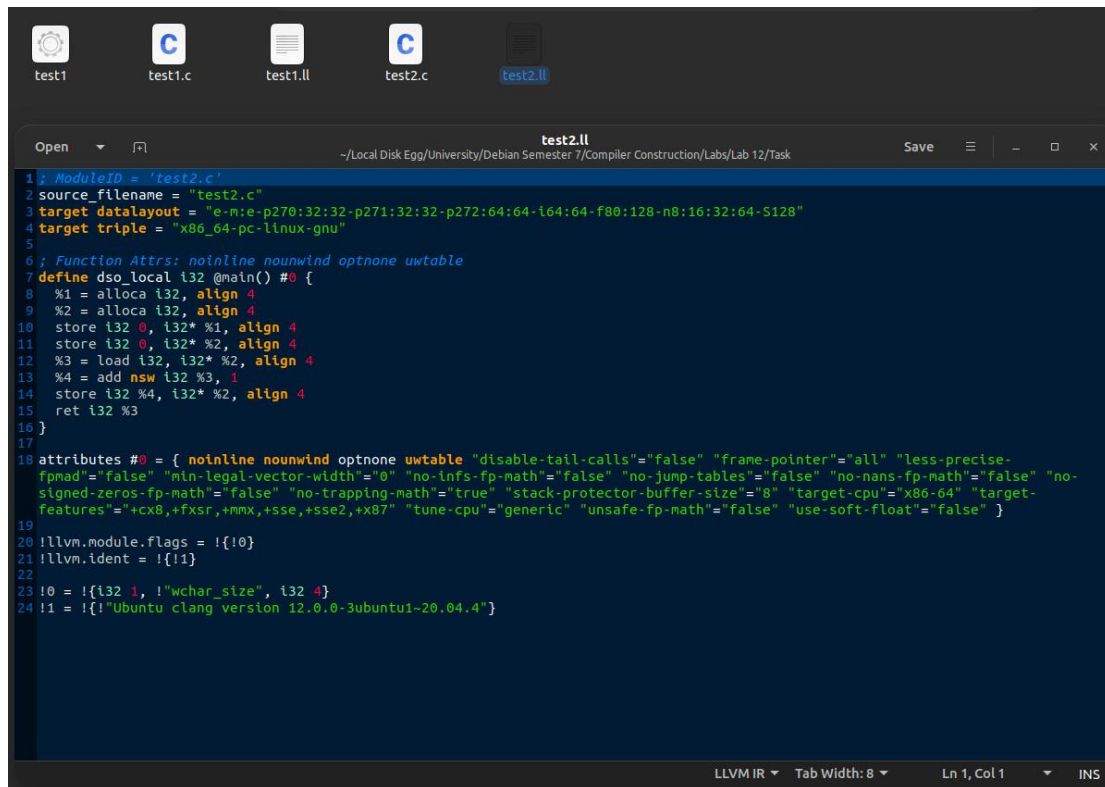
```
EXPLORER
TASK
test1
test1.c
test1.ll
test2.c

test2.c
1 int main ()
2 {
3     int x=0;
4     return x++;
5 }
```



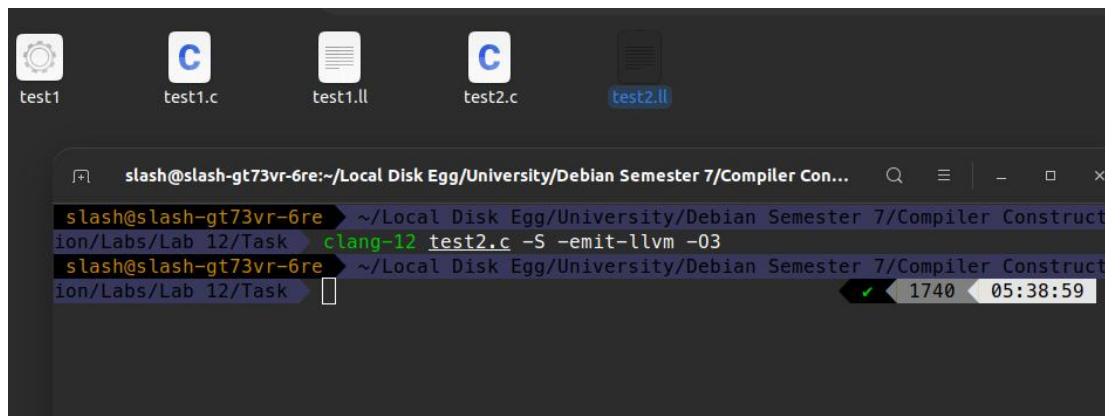
```
test1 test1.c test1.ll test2.c test2.ll

slash@slash-gt73vr-6re:~/Local Disk Egg/University/Debian Semester 7/Compiler Con...
slash@slash-gt73vr-6re ~/Local Disk Egg/University/Debian Semester 7/Compiler Construct
ion/Labs/Lab 12/Task clang-12 test2.c -S -emit-llvm SIGINT(2) 1739 05:37:54
slash@slash-gt73vr-6re ~/Local Disk Egg/University/Debian Semester 7/Compiler Construct
ion/Labs/Lab 12/Task clang-12 test2.c -S -emit-llvm 1739 05:37:55
```

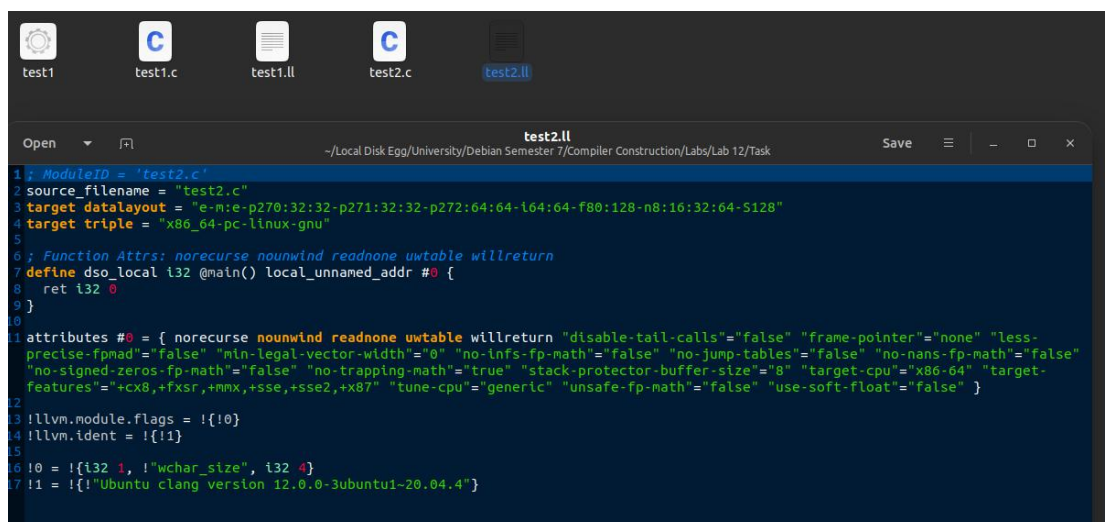


```
1; ModuleID = 'test2.c'
2 source_filename = "test2.c"
3 target datalayout = "e-m:e-p270:32:32-p271:32:32-p272:64:64-i64:64-f80:128-n8:16:32:64-S128"
4 target triple = "x86_64-pc-linux-gnu"
5
6; Function Attrs: noline nounwind optnone uwtable
7 define dso_local i32 @main() #0 {
8     %1 = alloca i32, align 4
9     %2 = alloca i32, align 4
10    store i32 0, i32* %1, align 4
11    store i32 0, i32* %2, align 4
12    %3 = load i32, i32* %2, align 4
13    %4 = add nsw i32 %3, 1
14    store i32 %4, i32* %2, align 4
15    ret i32 %3
16 }
17
18 attributes #0 = { noline nounwind optnone uwtable "disable-tail-calls"="false" "frame-pointer"="all" "less-precise-fpmad"="false" "min-legal-vector-width"="0" "no-infs-fp-math"="false" "no-jump-tables"="false" "no-nans-fp-math"="false" "no-signed-zeros-fp-math"="false" "no-trapping-math"="true" "stack-protector-buffer-size"="8" "target-cpu"="x86-64" "target-features"="+cx8,+fxsr,+mmx,+sse,+sse2,+x87" "tune-cpu"="generic" "unsafe-fp-math"="false" "use-soft-float"="false" }
19
20 !llvm.module.flags = !{!0}
21 !llvm.ident = !{!1}
22
23 !0 = !{i32 1, !"wchar_size", i32 4}
24 !1 = !{!"Ubuntu clang version 12.0.0-3ubuntu1~20.04.4"}
```

AND NOW OPTIMIZED :



```
slash@slash-gt73vr-6re:~/Local Disk Egg/University/Debian Semester 7/Compiler Construct
ion/Labs/Lab 12/Task$ clang-12 test2.c -S -emit-llvm -O3
slash@slash-gt73vr-6re:~/Local Disk Egg/University/Debian Semester 7/Compiler Construct
ion/Labs/Lab 12/Task$
```



```
1; ModuleID = 'test2.c'
2 source_filename = "test2.c"
3 target datalayout = "e-m:e-p270:32:32-p271:32:32-p272:64:64-i64:64-f80:128-n8:16:32:64-S128"
4 target triple = "x86_64-pc-linux-gnu"
5
6; Function Attrs: norecurse nounwind readnone uwtable willreturn
7 define dso_local i32 @main() local_unnamed_addr #0 {
8     ret i32 0
9 }
10
11 attributes #0 = { norecurse nounwind readnone uwtable willreturn "disable-tail-calls"="false" "frame-pointer"="none" "less-precise-fpmad"="false" "min-legal-vector-width"="0" "no-infs-fp-math"="false" "no-jump-tables"="false" "no-nans-fp-math"="false" "no-signed-zeros-fp-math"="false" "no-trapping-math"="true" "stack-protector-buffer-size"="8" "target-cpu"="x86-64" "target-features"="+cx8,+fxsr,+mmx,+sse,+sse2,+x87" "tune-cpu"="generic" "unsafe-fp-math"="false" "use-soft-float"="false" }
12
13 !llvm.module.flags = !{!0}
14 !llvm.ident = !{!1}
15
16 !0 = !{i32 1, !"wchar_size", i32 4}
17 !1 = !{!"Ubuntu clang version 12.0.0-3ubuntu1~20.04.4"}
```

Difference : As noticed here, Optimized Code has only one line in `dso_local` whereas there's many in non-optimized Code