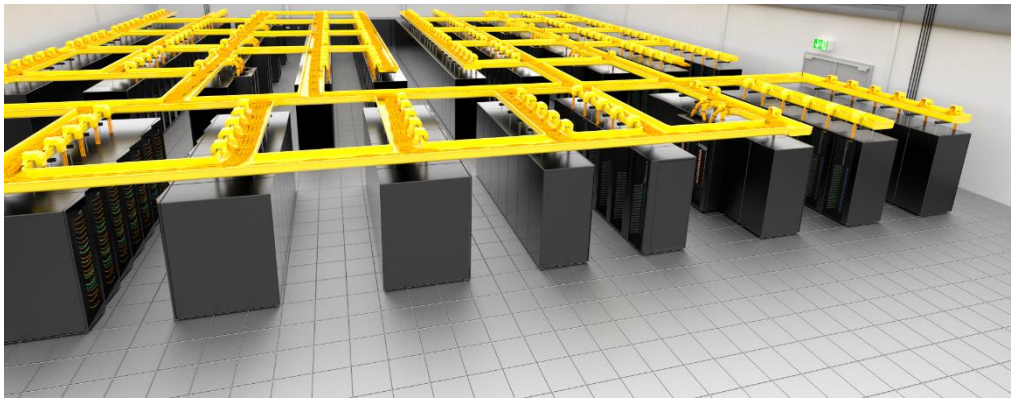
Leibniz Supercomputing Centre
of the Bavarian Academy of Sciences and Humanities

Eclipse: C/C++ Programming and Fortran



Carla Guillen
guillen@lrz.de

Tuesday, 19th of March 2015

Agenda

09:00-09:20 **Introduction to Eclipse, CDT and Photran**

09:20-10:10 **Hands-on Session 1 (Managed Build Project)**

- Creating a simple Managed Build Project

10:10-11:30 **Hands-on Session 2 (Makefile Project)**

- Importing existing code with Makefile into Eclipse.

11:30-12:30 **Lunch**

12:30-13:30 **Hands-on Session 3 (Makefile Project)**

- Coding features, building, running and debugging.
- Documentation with doxygen

13:30-14:15 **Exercises**

- What we learned but on C

14:15-14:30 **Introducing elements of Photran.**

14:30-14:40 **End / Continue with Hands-on with assisted help**

Why Eclipse

- **Open source and FREE!**
- **One IDE for almost all languages!**
- **Supported on most operating system**

OS independent GUI

- **Extensibility of features and tools**

You can find an app (plugin) for what you think you need

- **Easy to install**
- **Easy to use**
- **Stable Eclipse core**
- **A new release every year**
- **A big user community**

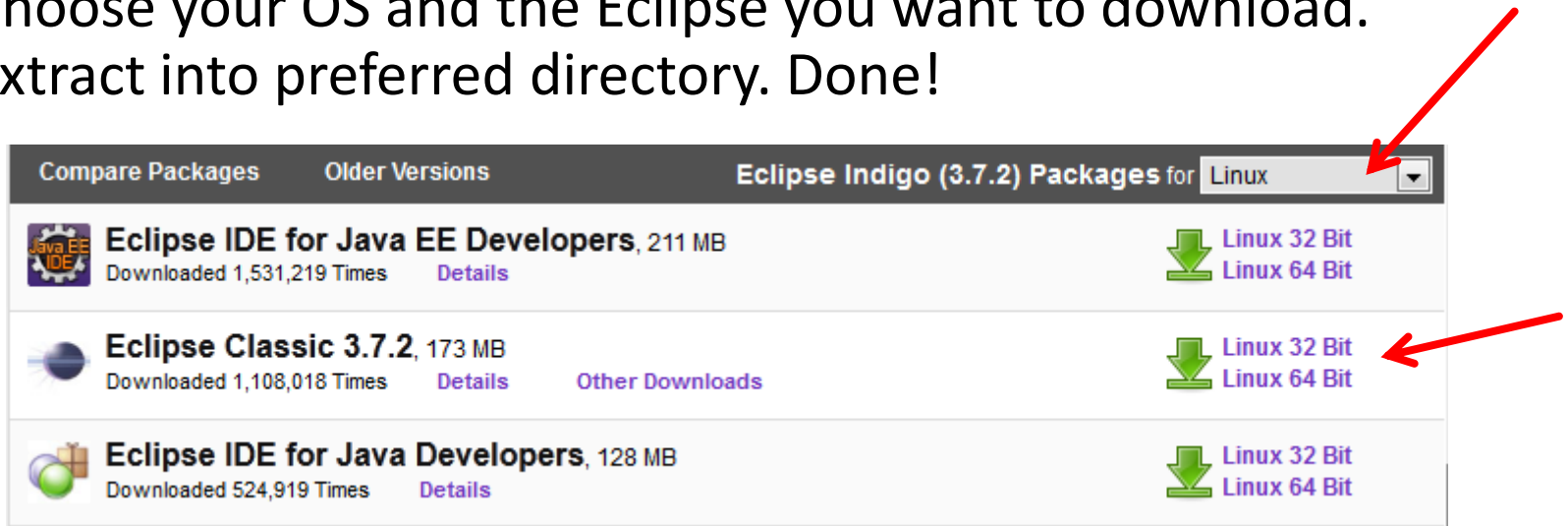
Introduction to Eclipse, CDT and Photran

Introduction to Eclipse

- **Multi-language *software development environment* comprising an *integrated development environment* and *an extensible plugin system***
- **Started by IBM (Canada) in late 1990s**
  - Goal
    - Development tools platform
    - Common platform for all IBM development products
    - Integrated experiences for the customers
- **Formed and created Eclipse Foundation (non profit org.) in 2003-2004**
  - Decoupled from IBM
- **Current version: Luna (June 2014)**
- **Next version: Mars (planned on June 2015)**
- **We will use the Kepler Version (from June 2013)**

How do I install Eclipse?

- **Java Development/Runtime Environment (preferred latest Java version 1.7)**
  - minimum JDK/JRE 1.5
  - 64 bit Eclipse should use 64 bit JDK/JRE
  - 32 bit Eclipse should use 32 bit JDK/JRE
- **OS:** Linux, Windows und Mac
- Go to http://www.eclipse.org/downloads/
- Choose your OS and the Eclipse you want to download. Extract into preferred directory. Done!



Introduction to Eclipse

What is eclipse essentially?

- a small Java program with loader functionality
- can be infinitely extensible by 3rd parties products
- products are created in the form of plugins which are then loaded by Eclipse

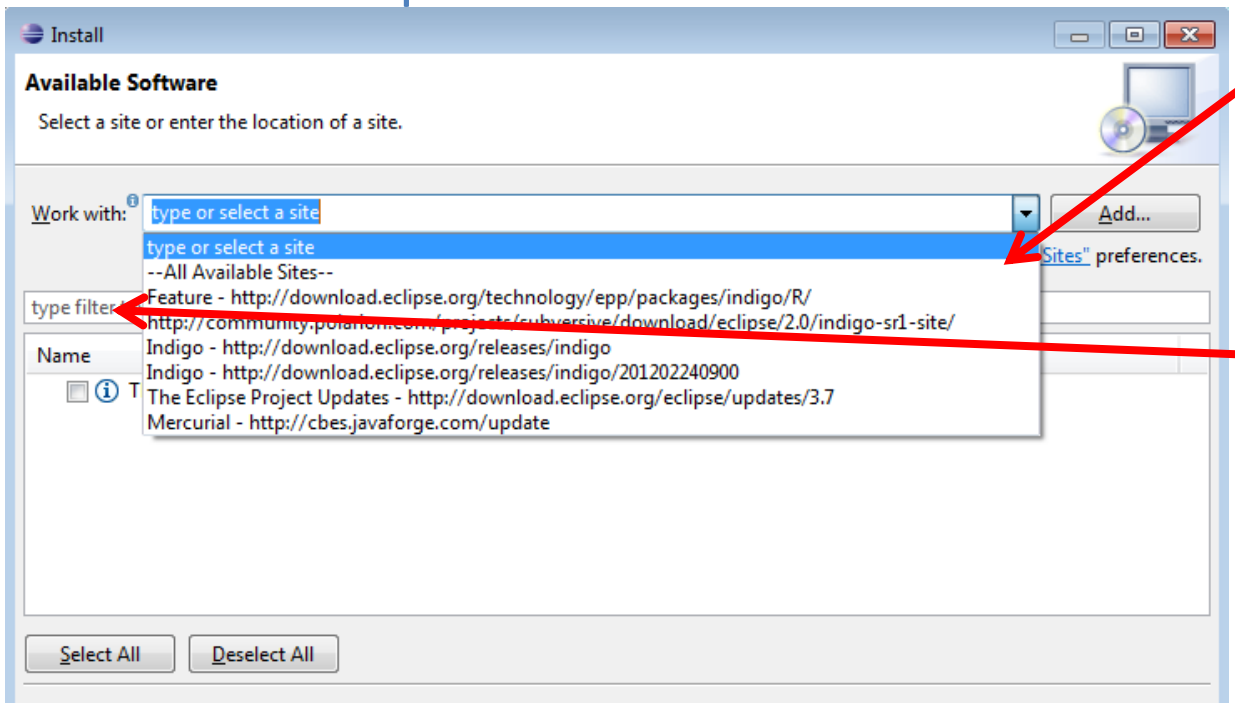
What is a plugin?

- a small unit of Eclipse platform that can be developed separately
- can be delivered as a single jar or a collection of jars
- self-describing: describe what it is, what it does and who it requires
- xml configuration

Reminder for myself : Show Eclipse!

How do I install a plugin?

- Go to Help->Install New Software

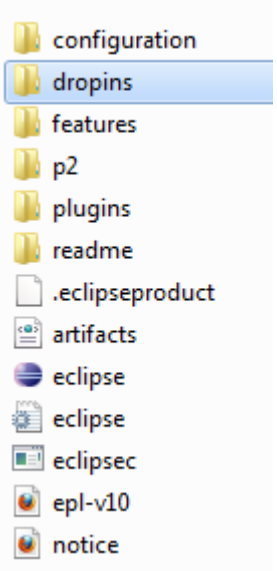


- Select a site to work with (or add one)
- Type in filter text what you are searching for. Hopefully it is there and you just need to select it.
- Eclipse will calculate dependencies

- You will be require to accept terms of license agreements, if you agree, Eclipse will install it.
- You will need to restart Eclipse.

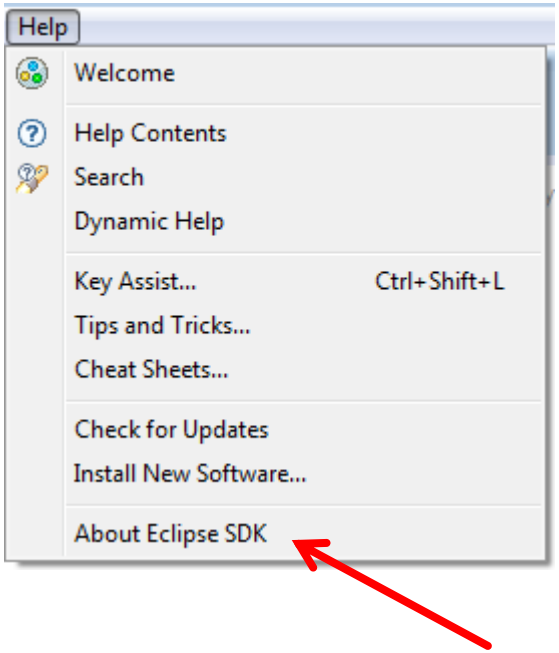
How do I install a plugin? (manually)

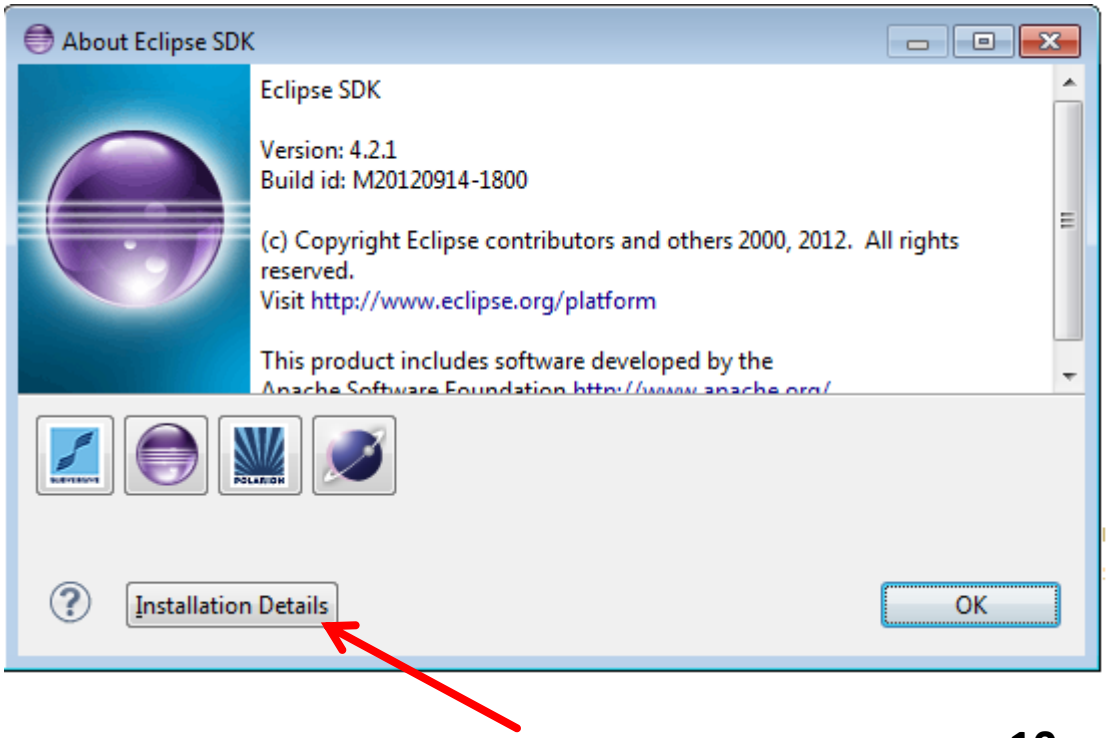
- There is a possibility to do it manually. Usually the reasons are rather uncommon.
- Go to the folder where eclipse is installed (/usr/lib/eclipse/ in Linux C:\Programs\Eclipse\ in Windows or your manually installed path).
- Download from the website the plugin. NOTE! Be careful to download only trusted plugins
- Put it in your folder dropins the downloaded plugin and restart eclipse!



How do I check which plugins Eclipse has installed?

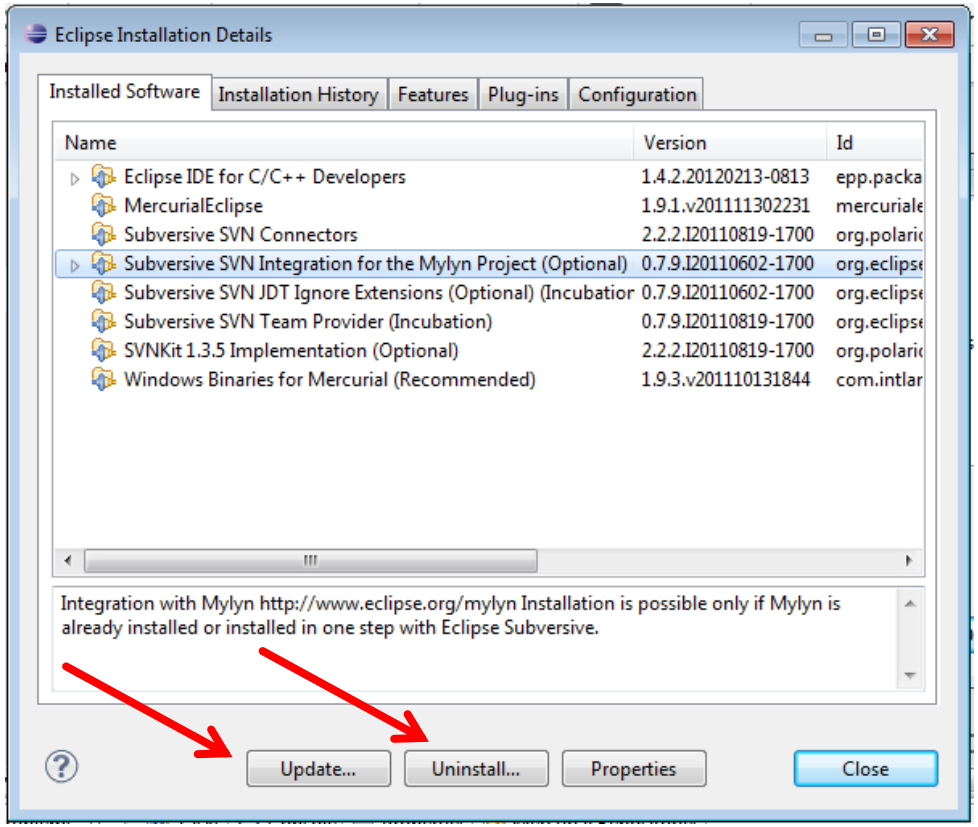
- Go to Help Menu → About Eclipse SDK → Installation Details





How do I update or uninstall a plugin?

- Go to installation details (previous slide) and there you will also find the options to update or uninstall.



What languages can I install?

Available plugins for different programming languages:

Java	C/C++	Fortran	Cobol
Python	Perl	PHP	Javascript
Ruby	ADA	LISP	C#
Lua	R	Pascal/Dephi	Curl
Flash			

others...

Glossary

Workspace: a logical collection of projects. Also a directory on your hard disk where Eclipse stores the projects you define

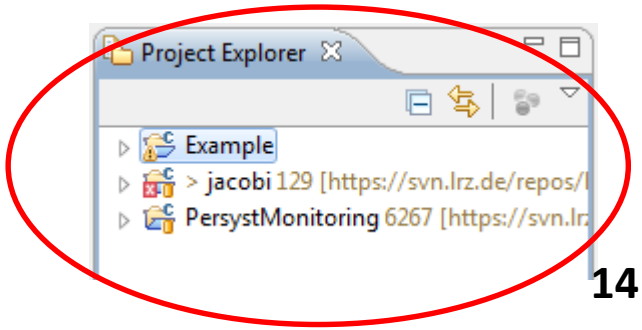
Perspective: determines the visible actions and views within a window. Provides mechanisms for task oriented interaction with resources, multitasking and information filtering

View: Used to navigate a hierarchy of information, open an editor or display properties for the active editor

Editor: Used to edit or browse a resource. You can use external editors to eclipse, but eclipse wont recognize the changes (use refresh F5 button)

Eclipse Workspace

- **Can have multiple switchable instances of workspace**
- **Features (can be modified in Preferences)**
  - Build automatically (default: on)
  - Save automatically before build (default: off)
  - Workspace save interval (default: 5 minutes)
  - Refresh automatically (default off)
  - Open referenced projects when a project is opened (default: prompt)



Introduction to CDT

Introduction to CDT

- Latest Version: CDT 8.6 (For Luna)
- We will be using CDT 8.3 (Kepler Version)
- The C/C++ development tool: Provides a fully functional C and C++ Integrated Development Environment based on the Eclipse platform
- **Features:**

  support for project creation

  managed build for various tool chains

  standard make build

  source navigation

  various source knowledge tools

  visual debugging tools

CDT Features

- **Check:** http://wiki.eclipse.org/CDT/User/NewIn82
- **Editor**
  - C/C++ syntax highlighting
  - Code completion (Camel Case Completion)
  - Hover help
  - Automatic indentation
- **Parser**
  - Parses source files in project to extract C/C++ elements
  - Information used to search, outline and code completion
- **Search**
- **API and extension points to allow extensibility**
- **C++ Development**
  - Class creation wizards

CDT Build Features

Common build strategies

- Managed Make
  - Manages compiles for various toolchains
  - No Makefile editing
  - Fine control over compile and link settings
- Standard Make
  - Re-using existing Makefiles
  - Simple integration with arbitrary build systems
  - Parsing the toolchain output to generate error makers.

CDT Debug Features

- **Portable source level debugger**
- **Various views that extend Eclipse debug framework**
  - Registers
  - Memory
  - Variables
  - Signals
  - Shared libraries
- **CDI (C Debugger Interface)**
  - MI (Machine Interface) plugin implementation (interface to GDB through machine independent interface)
  - Allows targeting of a wide variety of CPU architecture
  - CDI APIs allow programmatic control over debugger
  - Possible to use another debugger

Reminder for my self : Show CDT Perspective!

Introduction to Photran

Introduction to Photran

IDE and refactoring tool for Fortran
Latest version 8.1 (June 2013)
IDE features:

- Support for Fortran 77-2008
- Syntax-highlighting editor
- Outline view
- *Content assist*
- *Open declaration*
- *Declaration view and hover tips*
- *Fortran language-based searching*
- Support for CVS & other VCS's
- Interactive debugger (gdb GUI)
- Makefile-based compilation
- Optional Makefile generation
- Recognition of error messages from most popular Fortran compilers

Introduction to Photran

Refactoring functionalities

- Rename
- Extract Procedure
- Extract Local Variable
- Introduce IMPLICIT NONE
- Make Private Entity Public
- Encapsulate Variable
- Add ONLY to USE Statement
- Minimize ONLY List
- Make COMMON Consistent
- Move Saved Variables to COMMON
- Loop Interchange (Unchecked)
- Replace Obsolete Operators
- Change Keyword Case

Reminder: show Fortran perspective!

Eclipse @ LRZ

Available as modules on SuperMUC, SuperMIG and the Linux cluster the Juno Version.

```
>module load eclipse
```

Then type “eclipse” to run it.

- **For Hands-on:**

Eclipse C/C++ Development Tools (CDT) Version 8.2

Fortran Development Tools (Photran) Version 8.0

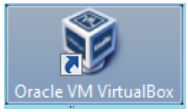
How to read these slides

- Blue means a name of a window, text box name, option name, keys to type together or buttons which already exists in Eclipse.
- Red is what we will type inside.
- I will tell you when I change a slide.
- Please read the slides when you get lost, they will guide you through.
- If you are behind two slides and can’t catch up, please ask for assistance!

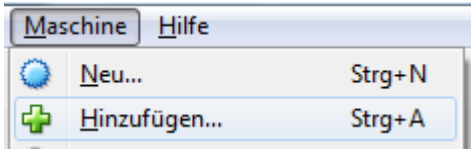
Hands On Session

Getting into Linux

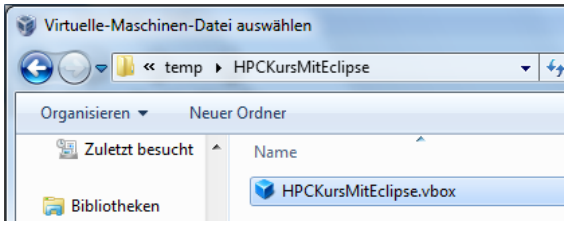
- Your computer has a Windows System but we will start a Linux Virtual Machine inside it.
- Click on the Oracle VM VirtualBox icon on the Windows Desktop. Alternatively, you can find it on the Start Menu.



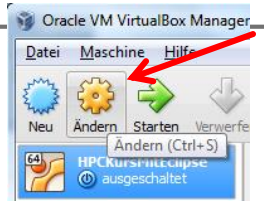
- Go to Maschine → Hinzufügen



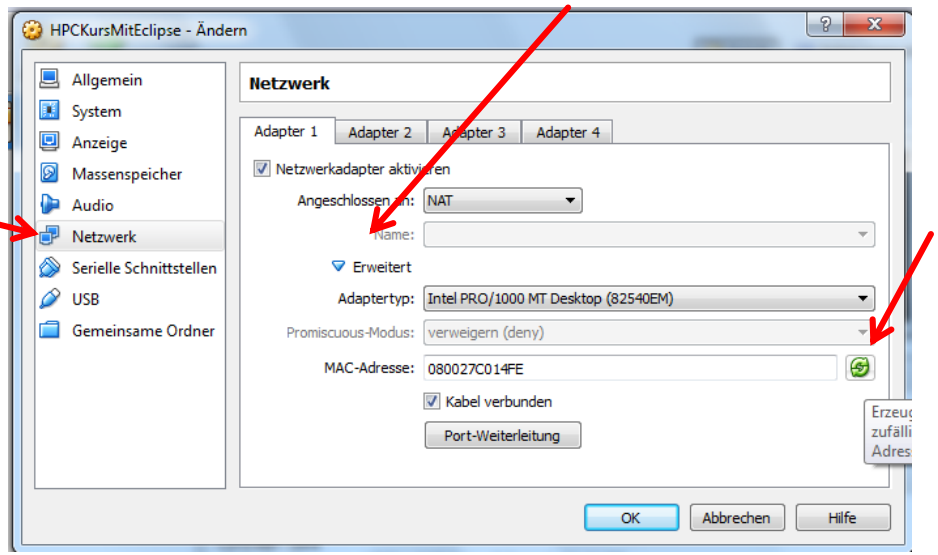
- Click to get to this path: C:\temp\HPCKursMitEclipse and click on HPCKursMitEclipse.vbox



Running the virtual machine

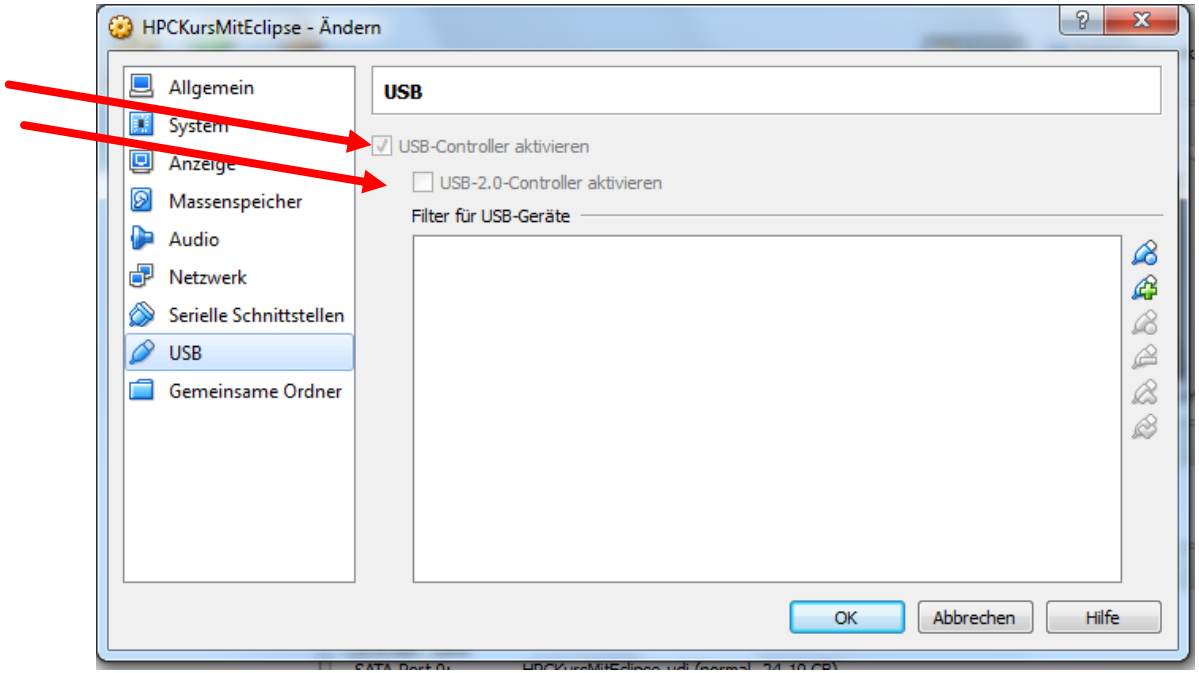


- We will first generate another MAC address.
- Click onf Ändern → Netzwerk (on the left)→ Expand Erweitert → click on the green symbol to generate a new MAC Address (MAC-Adresse:)



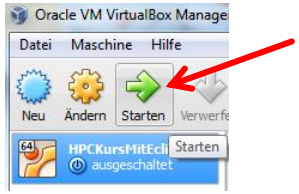
Running the virtual machine

- We will disable the configuration on USB.
- If both ticks are enabled then uncheck them.
- Finally, press OK.



Running the virtual machine

- Click on Starten
- If you get a warning screen, press OK .



Starting Eclipse

- Click on the Eclipse symbol, or as an alternative open a Terminal and type eclipse then enter.

```
>eclipse
```

- The Workspace Launcher window will open.
- Type in Workspace: /home/kursteilnehmer/workspace (probably default)

Getting Help

- If you get the welcome screen you can go to “tutorials” (otherwise go to workbench)
- You can always get this screen via Help Menu → Welcome
- Get help on the current platform What’s new → Eclipse Platform
- Other ways of getting help:

Help → Key Assist…

Help → Cheat Sheets

- Search in internet as well, there’s plenty of help for eclipse available!

Creating a simple project

- Change to your CDT perspective (Windows → Open Perspective → Other → C/C++)
- Go to File → New → Project… → expand C/C++ → C++ Project → Next
- In the text box Project name type in “HelloWorldExec”
- Choose in Project type the option Hello World C++ Project under the Executable folder.
- Under the Tool Chains select Linux GCC
- Select Next
- On the screen that just appeared write if you’d like, author, copyright notice, and so on…
- and the click on Finish.

Comfortably code on the big screen.

- Press Ctrl+M or double click on your editor

jacobi.cpp | main.cpp | Makefile | HelloWorldExec.cpp

```
//===========================================================================
// Name        : HelloWorldExec.cpp
// Author      : CG
// Version     :
// Copyright   : Your copyright notice
// Description : Hello World in C++, Ansi-style
//===========================================================================

#include <iostream>
using namespace std;

int main() {
    cout << "Hello World!!!" << endl; // prints Hello World!!!
    return 0;
}
```

Building and running a project

Managed build project

- Makefile is created for user
- make and make clean can be run via the Menu options: Go to Project → Build Project

Default setting:

- To select build release or build debug go to Project → Build Configurations → Set Active → Release or Debug
- Build Automatically (You can unselect it in Project → Build Automatically
- Running: Run → Run (Sometimes it appears as Run last application)
- You will be prompted a window: on the C Local Application window choose Local C/C++ Application → OK and then the generated binary (Release Version) HelloWorldExec
- Check your Console view

Clean

- Go to the Project Menu → Clean… → Clean projects selected below.
- Select your project and press OK

Using another compiler (another version of g++)

- On the Project Explorer view, right click and a menu will appear.
- Choose Properties on this menu.
- On the Properties Window that appears expand C/C++ Build → Settings
- The right side of this window will contain the details to configure. Choose on Configuration → [All Configurations]
- On Tab Tool Settings choose GCC C++ Compiler
- Type in the text box Command g++-4.6
- Do the same for the GCC C++ Linker and press OK.
- Try cleaning and building again!

Compilation errors

- On the Project Explorer, go to the HelloWorldExec.cpp file under src/
- Wrap your cout statement with and if statement introducing an error:

```
if(true){x
    cout << “Hello World!!” << endl;
}
```

Saving your file

- Use Ctrl + s
- File → Save
- Use the little disk 
- Save multiple files with 
- Now clean and build the project again (You should have already learned how!)
- See the error message in the Console view.
- Click on it, Eclipse will take you the line with the error.
- Go to the Problems view expand the error and see all the detailed errors. You can also click on them and Eclipse will take you to the line and file.

Compilation errors

- You will find several indications that there is an error: on your Project Folder, on the source code folder and on the source file itself.
- Leave the mouse pointer on the x is. A description of the error is written for you.
- Correct the error and type in an unknown variable x; Don't declare it yet!

```
if(true){
    cout << "Hello World!!" << endl;
}
x=2;
```

- Eclipse recognizes it immediately as a bug without the building step. (Bug symbol)

For simple errors get an answer!

- Eclipse will try to advise on the solutions you can code.
- So we created an unknown variable. Put the cursor on this variable. Press Ctrl+1 or right click on top and go to Quick Fix
- Choose for example: Create local variable
- Eclipse will “guess” the type and declare the variable for you.

Quick fix is very handy…

- Write a small routine (don't declare "y" yet!)

```
double getTwo();
int main(){
…
y = getTwo();
}

double getTwo(){
     return 2.0;
}
```

- Make a quick fix on y to declare this variable! Notice that Eclipse created at double the type that the function returns.

Selection Expansion

- Put your cursor over “cout”
- Go to Edit Menu → Expand Selection To → Enclosing Element
- Notice what happens, try this action five more times…
- Try the other items in Expand Selection To

Restore Last Selection

Next Element

Previous Element

Code completion

- Add the following code in red to generate random numbers:

```
#include <cstdlib>
int main (){
      srand(time(0));
      int randNumber = rand();
      cout << "randNumber = " << randNumber
      << endl;
      if(ran|){
            cout << "Hello World!!" << endl;
      }
}
```

- Check how code completion is done on ran: At the end of ran press Ctrl + Space (Type rand and try it again…)

Save your file…

- Add also this code:

```
if(randNumber % 2){
      cout << “odd number!” << endl;
} else {
      cout << “even number!” << endl;
}
```

Build code and run again!

- This time try it differently:
- Clean, build like you always do but:
- Now just press the  button to run.
- Check your console.

Refactor: extract function.

- Highlight the entire if-else block.
- Right click on this highlighting and when the menu appears, choose Refactor → Extract Function .
- On the Extract Function window that will appear, write under Function name: condition
- Click on Preview to compare the files.
- Click on OK and see how the function will be extracted.

Refactoring: renaming a variable

Now we would like to rename randNumber to randNum in our main().

- Highlight in your main the variable randNumber
- Right click on the variable.
- Choose Refactor → Rename…
- Change the name to randNum and press Enter!
- Now try this with the function name condition, rename to conditionEvenOdd

Correct your indentation

- On your created function conditionEvenOdd(…) remove all indentation. Let's suppose this was a mistake while you were coding.
- We will correct the indentation by:
- Highlight the entire function condition()
- Right click and on the menu choose:
- Source → Correct indentation.
- Ctrl + I on the highlighted text has the same effect!
- Equivalent is to go to Source → Format or Ctrl + Shift + F
  However, if the line is very long, Eclipse will accomodate it in more lines.

Comments

- Highlight or leave the cursor on the line

srand(time(0))

- Right click on it. Choose Source → Toggle Comment.
- Now you see it is commented with two slash forwards.
- Repeat the process to uncomment.
- The other option is to use Source → Add Block Comment. This will comment with /* … */
- To remove the block comment, you need to choose Source → Remove Block Comment.

Close your project.

- Go to the Project Explorer view and select the HelloWorldExec Project.
- Right click and select Close Project.
- All the files should have disappeared.

New Managed Project from Scratch!

- File → New → Project…
- On the New Project Wizard expand the C/C++ folder. Choose C++ Project → Next
- In the Project name: text box write lrzcourse and on the left menu Project type: expand the Executable folder. Select Empty Project.
- Select under Toolchains: the Linux GCC option.
- Click on Next → Finish. The project was hopefully created.

New Managed Project from Scratch!

- Now we will create the source folder. File → New → Source Folder
- On the new window New Source Folder write under Folder name: src and then click on Finish
- Click on your new src folder. Creating a new source file. File → New → Source File
- On the new window New Source File write under Source file: main.cpp and then click on Finish
- Expand the comment on main.cpp and check the automatic documentation.
- Go to the file you have just created. Go to line 8 and type main and the press Ctrl + Space

Code completion

- Outside (on top) of your main write:

```
#include <iostream>
using namespace std;
```

- Inside your main let's write a for-loop. Type
- for and then press Ctrl + Space. A list will appear. Choose for – for loop with temporary variable
- Change the name var to iter
- Press Tab and change max to 5.
- Write inside the for loop:

```
cout << "iter = " << iter << endl;
```

- Try building and running the code.
- Close your project when finished.

Create a project with an existing Makefile.

Importing existing code with Makefile from SVN

- Create a new project: File → New → Project
- In Select a wizard expand the SVN folder and then Project from SVN
- Click on Next
- The General tab should be active (otherwise choose it!)
- Enter on the URL textbox:

https://svn.lrz.de/repos/hlr_public/eclipse

- Click on Next and wait a few seconds.
- Click on Browse (It will take a few seconds before the available projects are displayed)
- Select the directory: example_cplusplus
- Click on OK and click on Finish

Using the New Project Wizard

- The new window Check Out As will appear
- Choose the option Check out as a project configured using the New Project Wizard
- Click on Finish
- In the New Project Wizard window expand the C/C++ folder
- Select C++ Project
- Click on Next

C++ Project with empty Makefile

- The C++ Project window appears
- Type in the Project name textbox: jacobi
- On Project type box expand the Makefile Project folder and then choose Empty Project
- On the Toolchains box choose Linux GCC
- Click on Next
- On the following window click on Advanced settings...
- A window called Properties for jacobi will follow.

In Advanced Settings...

- Select on the left hand side menu click on C/C++ Build
- On your right hand side you will see 3 tabs: Builder Settings and Behaviour and Refresh Policy.
- On Builder Settings deselect the Use default build command option
- Type on the Build command field:

  make -f ${workspace_loc:/jacobi}/Makefile

- Tipp: you can also put the full path for example:

make –f /some/path/to/makefilename but we won't do this!

Almost done importing from SVN ☺

- Now go to the Behaviour tab.
- On Behaviour tab, select the option Build on resource save (Auto build) and write heat on its field. Write the same on the text field Build (incremental build) (it should also be selected)
- Click on Apply, on Ok and this window will close.
- Back on the C++ Project window click on Finish
- All windows close down and a new one reappears: Secure Storage
- We have not a set a Secure Storage password so we will ignore this. Just press Cancel. The project will be checked out.

Oops… I forgot to click on Advanced Settings…

- You made the project without setting the builder? No problem! Right click on your project and select Properties
- Choose C/C++ Build
- Type in the Build Command:

  make –f {workspace_loc:/jacobi}/Makefile
- Go to the Behaviour tab
- Write on Build on resource save(Auto build):

  heat
- Build (incremental build):

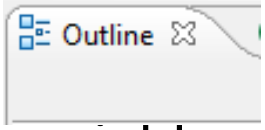
  heat
- Click on Apply and then Finish

A few more details on SVN: Compare files

- Click on Solver.cpp file
- Right click on it to compare with version.
- Choose Compare With → Revision or URL
- Select Revision then click on Browse (This action might take some time...) The Select Revision window will appear.
- Choose in the Revision column 111 and then OK. When taken to the previous window, select again OK.
- Press Ctrl + M and compare ! What's different? (Press Ctrl + M when finished with the comparison)
- You can also select 2 files and use Compare With → Each Other
- Or Compare With → Local History

CDT: Outline View

- Go to the main.cpp file and check the Outline view.



- Provides a quick view on procedures, variables, declarations, and functions that appear in source code.
- With outline you can easily jump into the appropriate reference in the source code.
- Check out the different buttons for sorting and hiding elements.

Hover
(What does this function contain?)

- On the main.cpp file go to the line 119. A quick way would be: Navigate menu → Go to Line and the type in 119.
- Put your cursor over the method jacobi_relax() if you leave it enough time the contents will appear. You can also press F2.
- If it doesn't look to good (usually it does…) highlight the contents of the box which appeared. You should be able to see the code.

Open declaration

Now we want to go to the file where this function has been defined:

- Put your cursor again over the method jacobi_relax() and press F3. You should have opened the file Solver.cpp

Remember F2 and F3 are very handy for navigating in a code!

Where am I using this variable?

- Go to the file ImageWriter.h and to the line 19. (Getting to this line quickly: Ctrl + L)
- Put the cursor on the member variable uvis
- Right click on it and choose References → Project
- Check the Search view. The list of places will be shown where this variable is being used.
- Click on the different locations of this list, Eclipse will take you to the lines where it is being used!
- Try this with a function!

More searching?

- Go to Search → Search…
- You can search on all .h files. In the tab File Search write on the Containing text w_time and on File name patterns: *.h
- Press the Search button. The Search view will show you again the location where this text is.
- Click on the found location.

Tasks for later: ToDos

- Go to the file input.cpp on the line 14 type in the following:

//TODO implement check_output.

- Go to the file ImageWriter.cpp on the line 12 and write the following:

//TODO improve ImageWriter constructor.

- Save all modified files.
- Go to the Tasks view, all your todo's are listed (Ideal for planning tomorrow's work!)

Hands-On Session 2

Coding: Create a new Class

- Right click on your jacobi Project
- Click on New → Class
- Write in Class name: Histogram.

Note you can choose here when you need it: a namespace, a base class...

- Click on Finish
- You should see two files, the Histogram.cpp and the Histogram.h file.
- Check them out!

Coding: getters and setters (in Java Style...)

- Click on your .h file on the new class you've just created.
- Type in the following code in red:

```
class Histogram {
private:
    double average;
    double * values;
    double * bins;
```

- Save your file.
- Right click inside the class Histogram. Choose Source → Generate Getters and Setters...
- Click on the desired getters and/or setters. Preview → OK and check your .h file.

Coding: Implementing a method.

- Write on your Histogram.h file the following code in red:

```
virtual ~Histogram();
double calc_std_deviation(int observ);
};
```

- Save the file. Right click on your method signature you have just created.
- Select Source →Implement Method...
- Select the method again (calc_std_deviation).
- Press Preview → OK
- Check your .cpp file !

Camel case completion

- Write the following member varibles on line 16 of your Histogram.cpp file:

```
int varNameOne;
int var_name_two;
```

Inside the calc_std_deviation type the following:

- vNO and then press Ctrl + Spacebar. Write some value into it.
- vNT and then press Ctrl + Spacebar.

The first capital letters are recognized and expanded!

Make target

- Go to the Make Target view on your right and click on the jacobi folder.
- Click on New Make Target and a Create Make Target window will appear. Write under Target name: heat and click on OK.
- Now double click on the heat target. Your jacobi program should build.
- Do another target for clean.

Note: this was not really necessary for the jacobi project, because we had already defined „heat“ as our default build target. We are just making targets in an alternative way.

Run

- Go to Run → Run configurations
- Double click on C/C++ Application

(You can also click on the New button to get the same result)

- On the C/C++ Application: text field write heat
- On the Project text field write jacobi
- Go to Arguments tab and write test.dat result.out
- Apply and Run ! (It might take some time until done…)
- Check the Console view.
- For debugging you can use your Run configuration already!
- Check your results: click on your project and refresh (F5) and check the result.out file.

Debug

Very important note:

Eclipse Debugger depends on GDB. Therefore: don‘t forget on your makefiles to include the –g option in the compilation process.

Makefile

```
CXXFLAGS =   -g -O2 -Wall -fmes

OBJS =       jacobi.o

LIBS =

TARGET =     jacobi.exe

$(TARGET):   $(OBJS)
    $(CXX) -o $(TARGET) $(OBJS
```

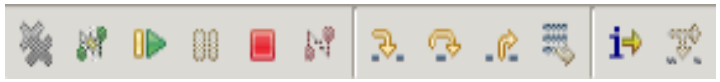
Debugging

- Go to Run → Debug configurations, select the jacobi application. Click on the Debug button.
- Accept opening the Debug perspective. (Click on Yes.
- Shortcut keys:
  - Step in: F5
  - Step over: F6
  - Step out: F7
  - Resume: F8

Step into (F5), Step over (F6), Step out (F7), Resume (F8)

F8

F5 F6 F7



- Press the green bug button to start debugging.
- Get familiarized with these buttons…

Exercises:

- Step over (F6) until you find on main.cpp this line of code:

```
if(!check_input(in, &maxiter, &resolution,
&algorithm, &numsrcs,
```

- Go into check_input(…) by pressing F5 and continue pressing a few times F6 on the input.cpp file.
- Get out of check_input(…) by pressing F7
- Continue pressing F6 on the main.cpp to go to

```
jacobi.jacobi_relax();
```

Step into it… F5

- Got lost? Press Stop and Start again

Set breakpoints

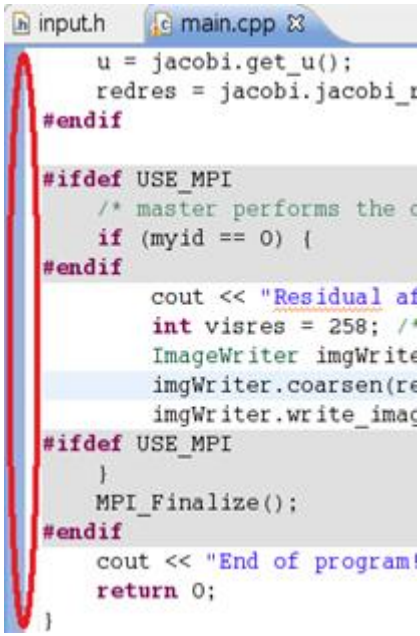
- If you are not already there go to line 115 from the Solver.cpp file and double click on the sidebar and set your breakpoint.

Configure your breakpoints:

- Go to the Breakpoints view.
- Right click on the breakpoint you just did. Click on Breakpoint Properties…
- Choose Common in the left menu

Type in the Condition text box: i == 5 & j==4

- Press OK and then press the Resume (F8) button to let the debugging continue…



See variables

- Go to the Variables view. Check that i is equal to 5 and j is equal to 4.
- Go to the Variables view again.
- Expand this. Right click on u and select Display As Array. Write in Start index: 3 and in Length 8 and press OK
- Now expand the folder of u and check the values!

Change the value of a variable

While debugging you can alter the variables

- Go to the Variables view.
- Click on the Value of npoints and change it to 100
- This will be the value that will stay until a new write is done!
- Go to the Expressions view and click on Add new expression
- Type in an expression with i, j and npoints:

```
i*npoints + j
```

- Step over (F6) a few times and see the value of the expression change.
- Terminate debugging by pressing the stop button.

Add Symbols

- Switch to the C/C++ Perspective.
- Go to the file main.cpp. We want to activate the MPI code that is greyed by eclipse.
- Right click on the jacobi Project.
- Select Properties. The window Properties for jacobi will appear. On the left menu select Paths and Symbols
- Here you can add also Includes an Libraries.
- Go to the #Symbols tab and choose GNU C++
- Click on Add… and in the Add symbol window type in Name: USE_MPI → OK
- The new variable will appear at the end of the list.
- Click on Apply → OK
- Check how your main.cpp has changed.

Add a new makefile target

- Go to the line 14 of the Makefile and type the following:
- Type the following:

```
histogram:
        $(CXX) -c $(OPTFLAGS) Histogram.cpp -o \
       Histogram.o
```

- Save the makefile and go to the Make Target view. On this view, click on the jacobi folder and then right click on it. Choose New…
- The Create Make Target will appear. Under Target name type in histogram
- Expand the jacobi folder in the Make Target view and double click on the histogram target we have just created.
- Check your Console view. If you have any errors try fixing them!

Documentation

- Windows menu → Preferences → expand C/C++ → Editor → Documentation tool comments → Change workspace default to Doxygen.
- Now let's test it: on the Histogram.h we will declare another method for the class. Right after calc_std_deviation

```
double calc_std_deviation(int observ);
double calc_percentiles(int p, double x, int m_val, double *vect, bool flag);
```

- Now we would like to document this function with doxygen style. Insert one line between calc_std_deviation and calc_percentiles. In this new line write /** and press enter. The skeleton for documentation should appear.

Exercises

Exercises

- Do a C project from scratch, the code could for example make a print out:
  - Try it with a managed build project: Configure the compiler to gcc-4.6.
  - Build
  - and run.
- Try also a project with a very simple makefile.
  - Write the code and the makefile of the following slide.
  - Direct the build command to the your created makefile.
  - Create another target.
  - Run the target.
  - Debug it, and check where the values are changing.

Code and Makefile:

```
#include <stdio.h>
#include <malloc.h>

int main(int argc, char **argv) {
    int n = 10, i = 0, j;
    int *u = (int *) malloc(n*n*sizeof(int));
    if(!u){
        printf("unable to allocate integer array\n");
        return -1;
    }
    for (i = 0; i < n - 1; i++) {
        for (j = i; j < n - 1; j++) {
            u[i * n + (j - 1)] = i * j;
        }
    }
    free(u);
    return 0;
}
```

```
exec:
    gcc main.c -o exec
```