

# Introduction to Programming

## Part 1: Why we need it?

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# Definition

**Computer programming** (often shortened to **programming** or **coding**) is the process of writing, testing, debugging, and maintaining the *source code* of *computer programs*. The purpose of programming is to create a program that exhibits a certain desired behaviour.

# Why geoscientists need programming skills?

# Why geoscientists need programming skills?

- To quickly obtain the data.
- Manipulation with huge amounts of data, extracting data that we need
- Data analysis.
- Data visualization.
- Presentation of the results (web,  $\text{\LaTeX}$ )

We need programming to do it **efficiently**.

Science is developing very fast. There is no “perfect” software, that will do exactly what you need

# Obtaining of data

Download all data files from the ftp directory:

“Simple” way

Index of <ftp://eclipse.ncdc.noaa.gov/>

[Go to higher level directory](#)

<a href="#">[ ] amsr-sghrc-v2_00000101.nc.gz</a>	1706 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000102.nc.gz</a>	1704 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000103.nc.gz</a>	1704 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000104.nc.gz</a>	1707 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000105.nc.gz</a>	1709 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000106.nc.gz</a>	1714 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000107.nc.gz</a>	1714 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000108.nc.gz</a>	1714 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000109.nc.gz</a>	1719 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000110.nc.gz</a>	1712 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000111.nc.gz</a>	1711 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000112.nc.gz</a>	1714 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000113.nc.gz</a>	1721 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000114.nc.gz</a>	1720 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000115.nc.gz</a>	1719 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000116.nc.gz</a>	1719 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000117.nc.gz</a>	1712 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000118.nc.gz</a>	1715 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000119.nc.gz</a>	1712 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000120.nc.gz</a>	1709 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000121.nc.gz</a>	1710 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000122.nc.gz</a>	1710 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000123.nc.gz</a>	1712 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000124.nc.gz</a>	1707 KB	06/25/2009 12:00:00 AM
<a href="#">[ ] amsr-sghrc-v2_00000125.nc.gz</a>	1709 KB	06/25/2009 12:00:00 AM

“Difficult” way

```
ftp> mget *
```

## “Simple” way

“Difficult” way

# Data analysys

Average of every second record :

“Simple” way

inputCTD.txt - OpenOffice.org Calc

File Edit View Insert Format Tools Data Window Help

Average

=AVERAGE(B3:B5;B7:B9;B11;B13;B15;B17;B19)

	A	B	C	D	E	F
1	DEPTH	TEMPERATURE	SALINITY			
2	10	-0.73	29.24			
3	15	-1.15	30.99			
4	20	-1.58	32.56			
5	25	-1.56	33.17			
6	30	-1.66	33.5			
7	35	-1.58	33.7			
8	40	-1.46	33.62			
9	45	-1.45	33.9			
10	50	-1.44	33.96			
11	55	-1.44	34			
12	60	-1.44	34.05			
13	65	-1.44	34.08			
14	70	-1.44	34.11			
15	75	-1.43	34.15			
16	80	-1.43	34.16			
17	85	-1.42	34.2			
18	90	-1.41	34.25			
19	95	-1.38	34.3			
20	100	-1.37	34.31			
21		=AVERAGE(B3;B5;B7;B9;B11;B13;B15;B17;B19)				

“Difficult” way

```
>> avrg = mean(temperature(2:2:end))

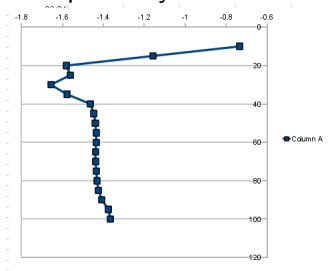
avrg =

-1.4274
```

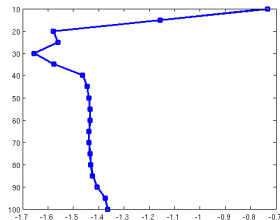
# Data visualization

## Plot Temperature vs Depth

“Simple” way



“Difficult” way



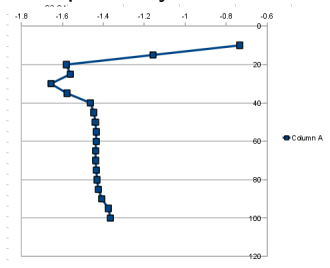
```
plot(temperature, depth, 's')
set(gca, 'ydir', 'reverse')
```



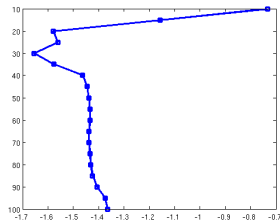
# Data visualization

## Plot Temperature vs Depth

“Simple” way



“Difficult” way

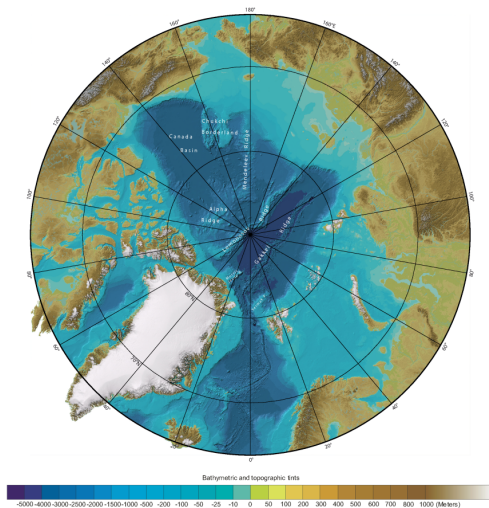


```
plot(temperature, depth, '-s')
set(gca, 'ydir', 'reverse')
```

But what if you need 1000 plots?

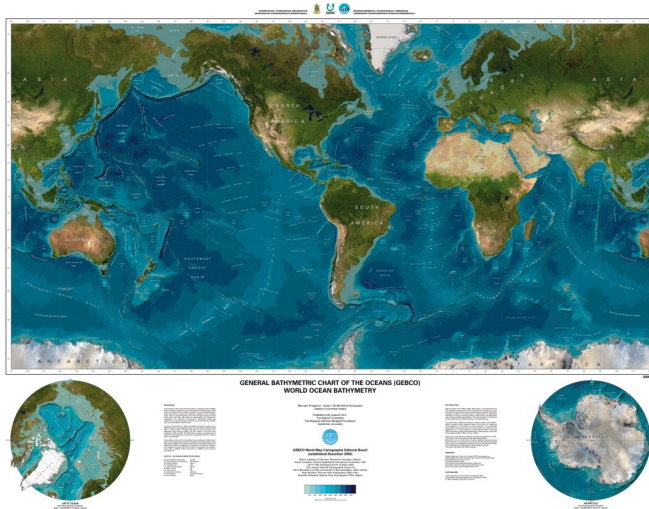
# Data visualization

## IBCAO



# Data visualization

## GEBCO



# Presentation of results

## Web

```

<!-- pageHeader -->

<div id="pageHeader">
  <div id="pageHeaderRight">

    <h1 id="home"><a href="/">БКОНТАКТЕ</a></h1>

  </div>

  <div id="quickSearch">
    <div id="query">
      <input id="qinput" autocomplete="off" onkeyup="friendFilter(event)" onfocus="searchOn(this)" onblur="searchOut(this)"
    </div>
  </div>
  <div id="qfriends"></div>
  <div id="qdropdown" onmouseout="setTimeout('startHide()',1200); qOn = 0;"></div>
  <script type="text/javascript">
    ge('qinput').value = winToUtf('Search');
  </script><div id="topNav" class="headNav">
    <div></div>
    <a href="http://login.vk.com/?act=logout&vk=5hash=9d33a9971850b4dc71">Logout</a>
    <a href="/gsearch.php?from=apps">Applications</a>
    <a href="/gsearch.php?from=people&basic=1&c[name]=1&sort=1">People</a>
    <a href="/gsearch.php?from=groups">Groups</a>
    <a href="/i1.php?act=a_box&popup=1" target="_blank" onclick="im_popup(); return false;">Instant Messaging</a>
    <a href="/id143493">Home</a>
  </div>
  </div>
</div>

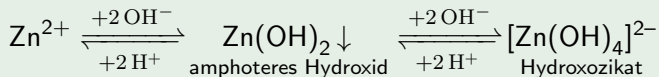
<!-- End pageHeader -->

```

# Presentation of results

L<sup>A</sup>T<sub>E</sub>X

## Example



## Example

$$\begin{aligned} B_g &= \frac{1}{h} \left( B_{in} - \int_{-h}^0 B_{Ek} dz \right) \\ &= \frac{1}{h} \frac{g}{\rho_0} \left( \frac{\alpha Q_{net}}{C_w} - \rho_0 \beta S_{net} \right) - \frac{1}{h} \int_{-h}^0 \frac{g}{\rho_0} \frac{1}{\rho f} \vec{k} \times \frac{\partial \tau}{\partial z} \cdot \nabla \sigma_m dz \\ &= \frac{1}{h} \frac{g}{\rho_0} \left( \frac{\alpha Q_{net}}{C_w} - \rho_0 \beta S_{net} \right) - \frac{g}{\rho_0} \frac{1}{\rho f \delta_e} \vec{k} \times \tau \cdot \nabla \sigma_m \quad (1) \end{aligned}$$

# You need it to get a job

## [CLIMLIST] Vacancy: Postdoctoral position at NOAA Univ. of Michigan (USA)

hydrology or other physical sciences will be considered. Ability to program in Fortran and use Linux is required, and experience with RAMS will be a great

## [CLIMLIST] Vacancy: Ph. D. position in climate dynamics at (IFM-GEOMAR) in Kiel (Germany) [Inbox](#) [X](#)

the development of simple theoretical models. Requirements for the candidate are a very good physical/mathematical understanding, interest in mathematics and theoretical geo fluid dynamics, programming and a high motivation for an independent and creative study. One of the

## Vacancy: Positions at Potsdam Inst for Climate Impact Research (Germany) [Inbox](#) [X](#) [Subs\\_clim](#) [X](#)

A one year position working on the emission allocation module within PRIMAP's emission module. Solid programming experience in MATLAB is required. You will be working within a vibrant team that is getting

## [CLIMLIST] Vacancy: Sea Ice Modeler Position at CSIRO (Australia) [Inbox](#) [X](#)

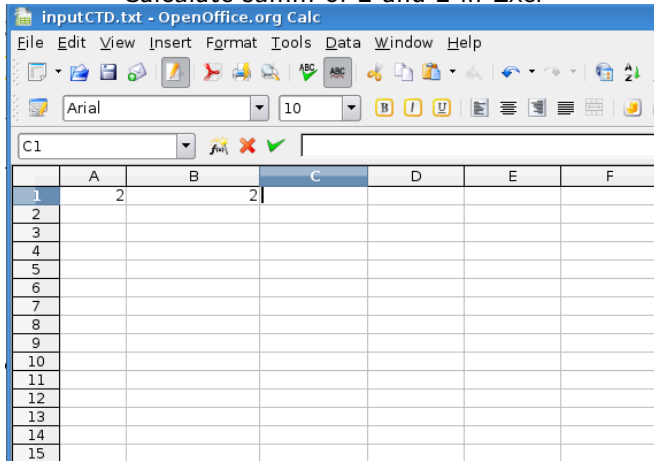
☆ **CLIMLIST** to climlist

To be successful in this role, you will have:

1. a PhD (or equivalent) in any of atmospheric science, physics, meteorology, earth system science, mathematical modelling;
2. significant experience in the use and development of large scale sea ice models;
3. demonstrated high proficiency in Fortran 90 (preferred) or another computer programming language.
4. demonstrated ability to work as part of a team in solving scientific problems, achieving joint goals.

# You already have some programming skills

## Calculate sum of 2 and 2 in Exel



# You already have some programming skills

Here is the source code of your program:

```
A1+B1
```

When you press Enter the program is executed and print the result:

```
4
```



# You already have some programming skills

Here is the source code of your program:

```
A1+B1
```

When you press Enter the program is executed and print the result:

```
4
```

Programs should be written in a programming language.