

Uvodna vježba iz Digitalne elektronike

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Digitalna elektronika

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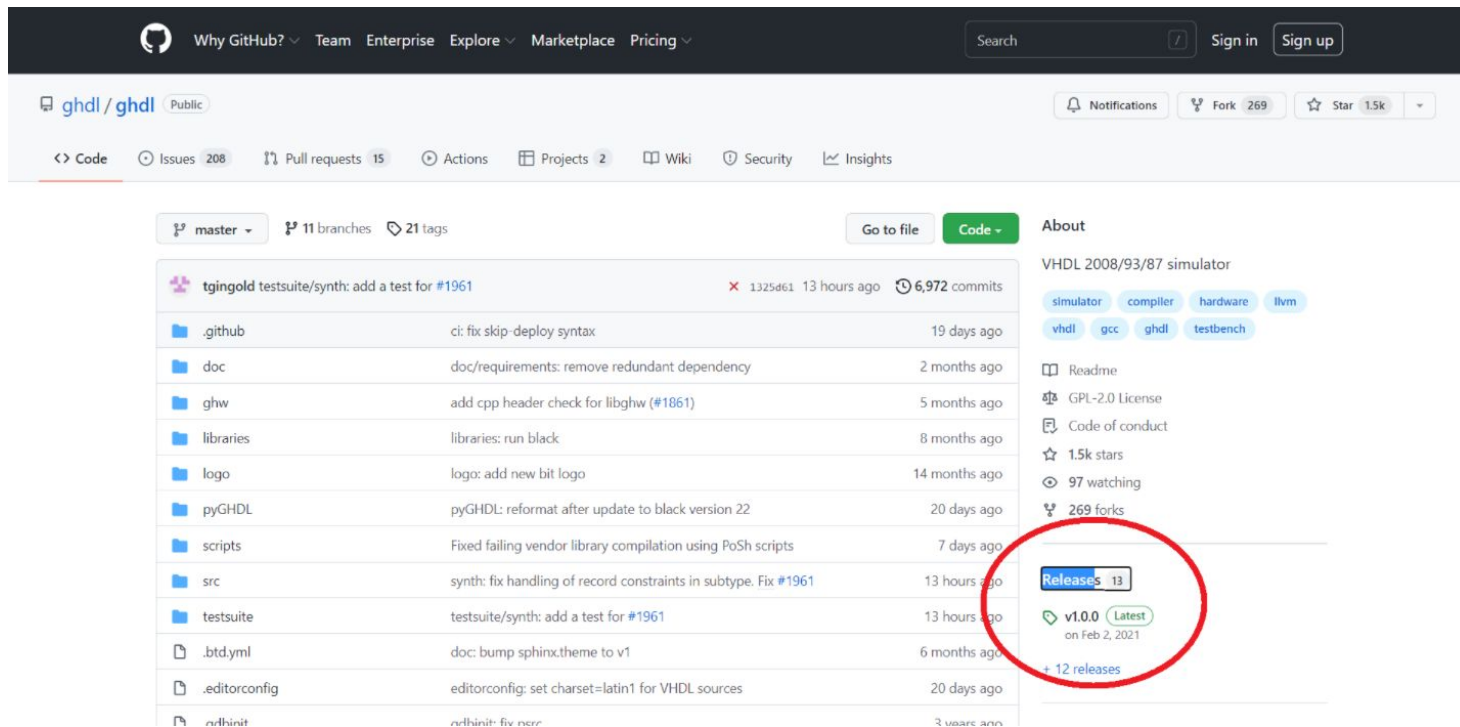
- Vježbe će se izvoditi online
- Svaka vježba se boduje i potrebno je da je uradite samostalno
- Na vježbama za koje je potrebno biće postavljen pripremni materijal

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- Za izradu prvog dijela vježbi vježbi koristiće se GHDL softver za kompilaciju i simulaciju VHDL koda
<https://github.com/ghdl/ghdl>
- Za izradu drugog dijela vježbi koristiće se Proteus softverski paket
www.labcenter.com/downloads/

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- GHDL softver možete preuzeti sa GitHub stranice:



The screenshot displays the GitHub repository page for `ghdl/ghdl`. The repository is public and has 208 issues, 15 pull requests, 2 projects, and 1.5k stars. The repository structure is shown on the left, with files and folders like `.github`, `doc`, `ghw`, `libraries`, `logo`, `pyGHDL`, `scripts`, `src`, `testsuite`, `.btd.yml`, `.editorconfig`, and `rdthinit`. The commit history is shown in the middle, with the latest commit being `tingold testsuite/synth: add a test for #1961` 13 hours ago. The right sidebar shows the repository's description, "VHDL 2008/93/87 simulator", and a list of tags including `simulator`, `compiler`, `hardware`, `llvm`, `vhdl`, `gcc`, `ghdl`, and `testbench`. The "Releases" section is highlighted with a red circle, showing the latest release `v1.0.0` on Feb 2, 2021, with 12 releases in total.

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- Otići na releases i zatim preuzeti verziju **v0.37**









(ghdl-0.37.mingw32-mscode.zip)

[v0.37](#)

Downloads (all):

downloads@v0.37 24k

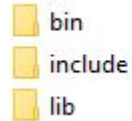
▼ Assets 14

| | |
|--------------------------------------------------------------------------------------------------------------------------------------|---------|
|  ghdl-0.37-buster-mcode-gpl.src.tgz | 3.85 MB |
|  ghdl-0.37-buster-mcode-gpl.tgz | 2.68 MB |
|  ghdl-0.37-buster-mcode-synth.tgz | 3.57 MB |
|  ghdl-0.37-buster-mcode.tgz | 3.01 MB |
|  ghdl-0.37-fedora31-llvm.tgz | 6.55 MB |
|  ghdl-0.37-fedora31-mcode.tgz | 2.93 MB |
|  ghdl-0.37-macosx-mcode.tgz | 2.22 MB |
|  ghdl-0.37-mingw32-mcode.zip | 4.89 MB |
|  ghdl-0.37-mingw64-llvm.zip | 20 MB |
|  ghdl-0.37-ubuntu16-llvm-3.9.tgz | 6.51 MB |
|  ghdl-0.37-ubuntu16-mcode.tgz | 2.89 MB |
|  ghdl.1 | 165 KB |
|  Source code (zip) | |

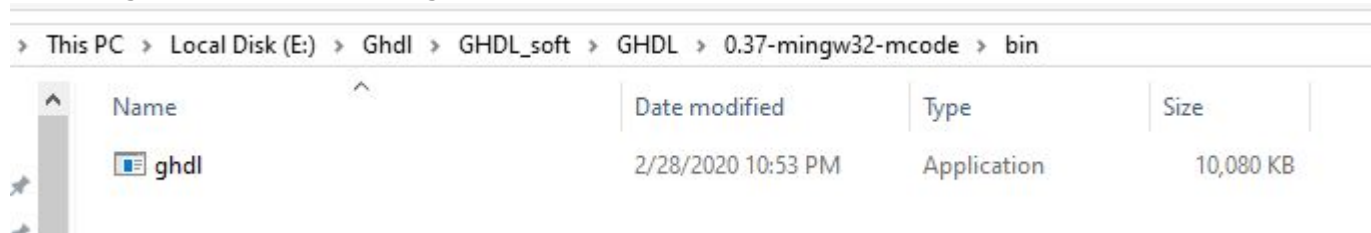


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- Preuzete fajlove ekstrahovati u folder po želji



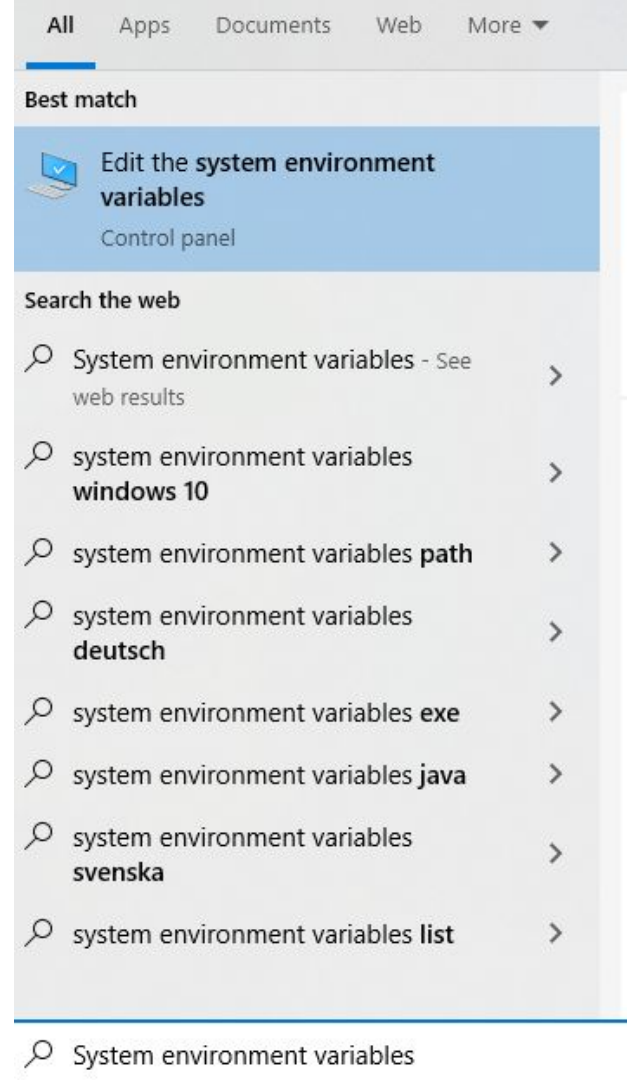
- Putanju (vaša putanja)/bin dodati u Environment Path



(Primjer putanje E:\Ghdl\GHDL_soft\bin)

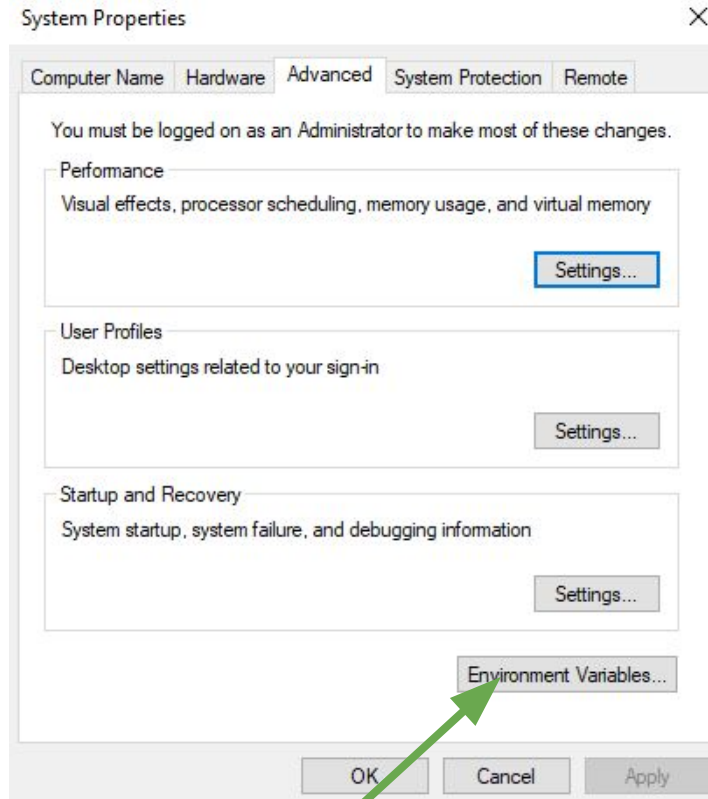
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Priskom na *windows* dugme dobijate mogućnost unosa teksta. Tu ćete potražiti System environment variables.



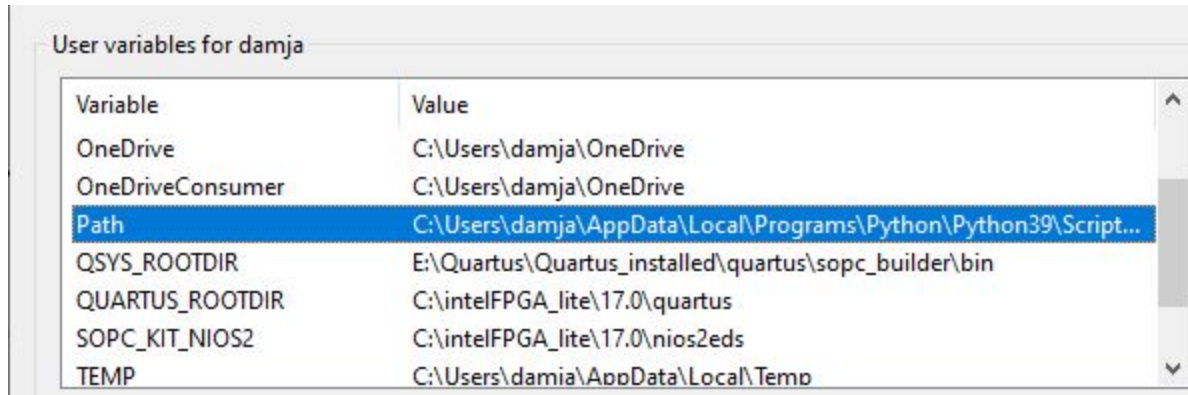
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Zatim “Environment Variables”



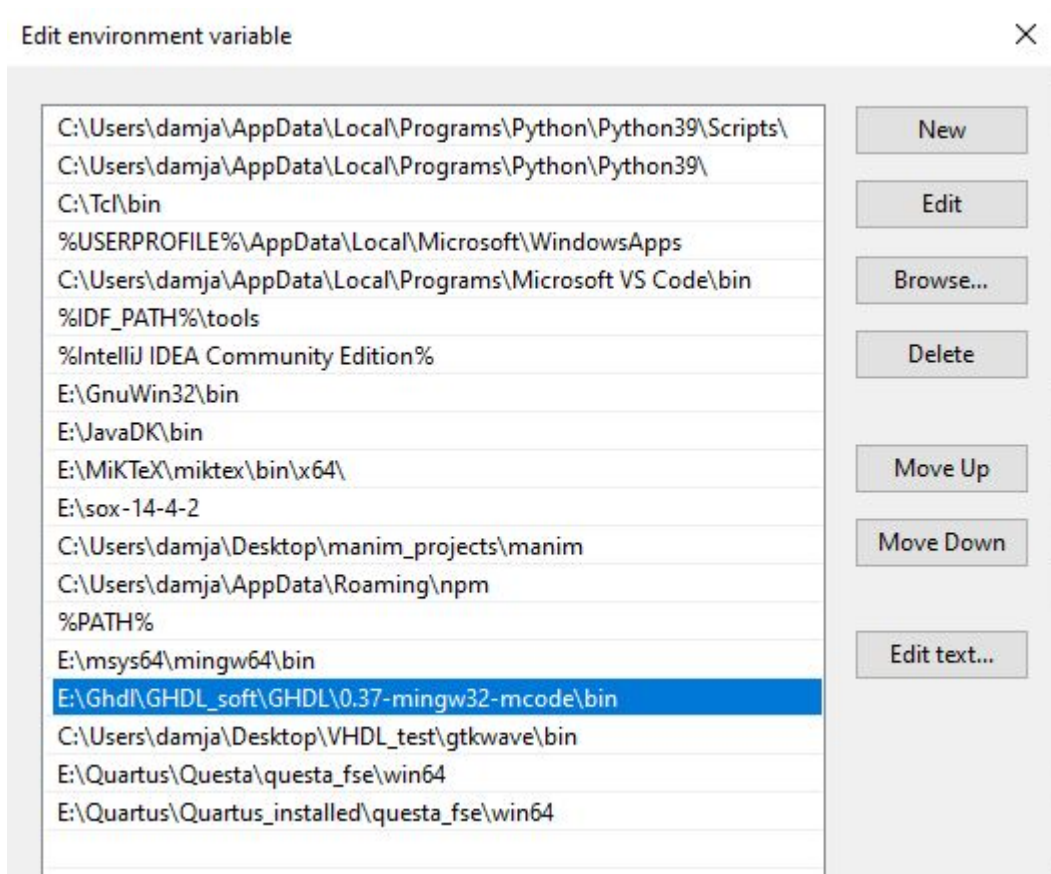
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Zatim u PATH varijablu dodati prethodno navedenu putanju.



| Variable | Value |
|------------------|-----------------------------------------------------------------|
| OneDrive | C:\Users\damja\OneDrive |
| OneDriveConsumer | C:\Users\damja\OneDrive |
| Path | C:\Users\damja\AppData\Local\Programs\Python\Python39\Script... |
| QSYS_ROOTDIR | E:\Quartus\Quartus_installed\quartus\sopc_builder\bin |
| QUARTUS_ROOTDIR | C:\intelFPGA_lite\17.0\quartus |
| SOPC_KIT_NIOS2 | C:\intelFPGA_lite\17.0\nios2eds |
| TEMP | C:\Users\damia\AppData\Local\Temp |

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Da bi se mogli vizuelizovati rezultati simulacije, potrebno je preuzeti GTKWave softver.

gtkwave.sourceforge.net/

Welcome to GTKWave

GTKWave is a fully featured [GTK+](#) based wave viewer for Unix, Win32, and Mac OSX which reads LXT, LXT2, VZT, [here](#).



For svn acc
svn ch

Native Win32 and OSX binaries are available [here](#), however if you are a Windows user running Cygwin, running under t
A Mac port can be found both [here](#) and [here](#).
Ports to other platforms which GTK supports should be trivial.



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gtkwave Files

Brought to you by: [gtkwave](#), [joel1234567](#)

| | | | | |
|---------|--------------|---------|---------|------|
| Summary | Files | Reviews | Support | Wiki |
|---------|--------------|---------|---------|------|

 **Download Latest Version**
gtkwave-3.3.100-bin-win32.zip (13.7 MB)

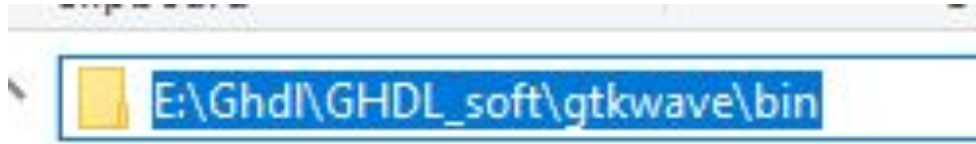
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- Ponovo ekstraktujete preuzete fajlove u željeni folder i dodate bin folder od GTKWave softvera u PATH varijablu kao i za GHDL.

Primjer putanje:



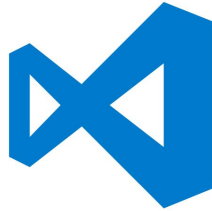
E:\Ghd\GHDL_soft\gtkwave\bin

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Sada je sve spremno da testirate instalirani softver.

Otvorite editor teksta po izboru. Preporuka: koristite VSC (Visual Studio Code)

code.visualstudio.com



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Napravite novi fajl, pod nazivom prviTest.VHDL i u njega unesite:

```
library IEEE;  
use IEEE.std_logic_1164.all;
```

```
entity or_gate is  
port(  
  a: in std_logic;  
  b: in std_logic;  
  q: out std_logic);  
end or_gate;
```

```
architecture rtl of or_gate is  
begin  
  process(a, b) is  
  begin  
    q <= a or b;  
  end process;  
end rtl;
```


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Zatim ponovo napravite novi fajl (prviTestTestbench.VHDL) i unjega unesite testbenč za prethodno napisano ILI kolo u prvom testu.

```
library IEEE;
use IEEE.std_logic_1164.all;

entity testbench is
end testbench;

architecture tb of testbench is

component or_gate is
port(
  a: in std_logic;
  b: in std_logic;
  q: out std_logic);
end component;

signal a_in, b_in, q_out: std_logic;

begin

  DUT: or_gate port map(a_in, b_in, q_out);
```

```
process
begin
  a_in <= '0';
  b_in <= '0';
  wait for 1 ns;
  assert(q_out='0') report "Fail 0/0" severity error;

  a_in <= '0';
  b_in <= '1';
  wait for 1 ns;
  assert(q_out='1') report "Fail 0/1" severity error;

  a_in <= '1';
  b_in <= 'X';
  wait for 1 ns;
  assert(q_out='1') report "Fail 1/X" severity error;

  a_in <= '1';
  b_in <= '1';
  wait for 1 ns;
  assert(q_out='1') report "Fail 1/1" severity error;

  -- Clear inputs
  a_in <= '0';
  b_in <= '0';

  assert false report "Test done." severity note;
  wait;
end process;
end tb;
```

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Sada kada je VHDL kod i testbenč napisan. Potrebno je kompajlirati kod i izvršiti simulaciju.

Na linku se nalazi detaljno opisan GHDL softver: ghdl.free.fr/ghdl/index.html

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Otvorite command shell ili Power shell i postavite se na mjesto gdje ste sačuvali vaše VHDL fajlove.

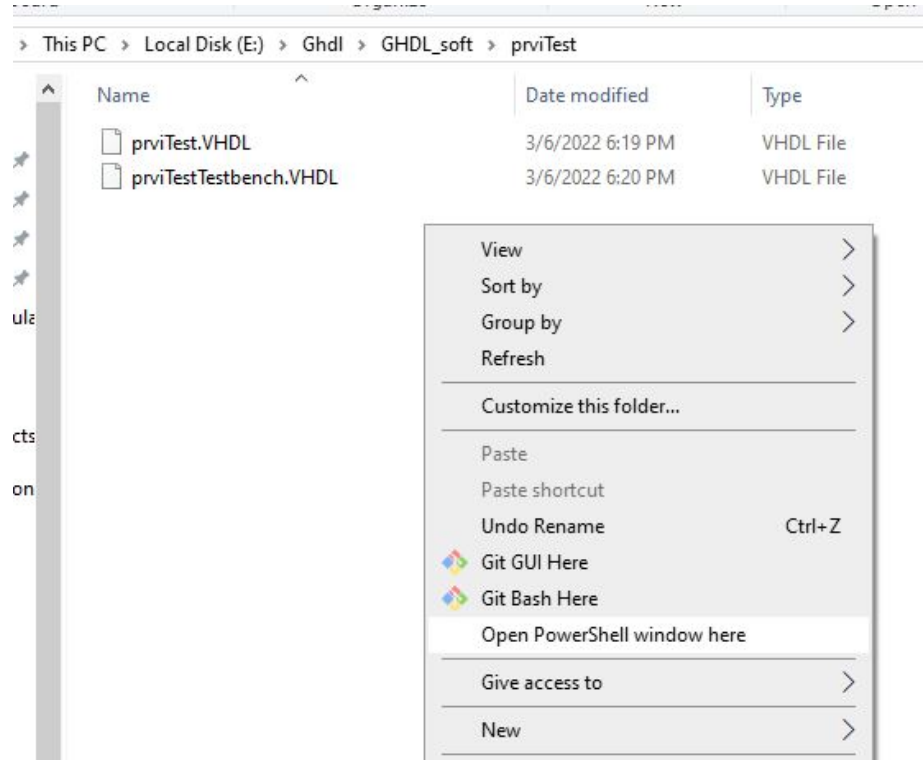
Da bi ste dobili opciju

Open PowerShell window here

Potrebno je da držite taster shift



I izvršite desni pritisak miša na

Prazan prostor.



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Prikaz dijela prozora PowerShell-a

| Name | Date modified | type | Size |
|----------------------------------------------------------------------------------------------------------|------------------|-----------|------|
|  prviTest.VHDL | 3/6/2022 6:19 PM | VHDL File | 1 KB |
|  prviTestTestbench.VHDL | 3/6/2022 6:20 PM | VHDL File | 1 KB |



```
Windows PowerShell
PS E:\Ghd1\GHDL_soft\prviTest> _
```

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Da biste kompajlirali vaš VHDL kod, u PowerShell unesite naredbu:

```
ghdl -a prviTest.vhdl
```

Izvršenje ove naredbe rezultuje CF File fajlom (npr. work-obj93.cf) ili greškom u slučaju da imate nekih nepravilnosti u VHDL kodu. Kada dobijete cf fajl, to znači da vaš VHDL nema greške u sintaksi.

Isto uraditi i za testbenč.

```
ghdl -a prviTestTestbench.vhdl
```

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Nakon toga, napravite izvršni fajl tako što pokrenete testbenč naredbom u powerShell-u

```
ghdl -e or_gate
```

(or_gate je naziv komponente koja se testira)

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Za vizuelizaciju signala iz simulacije koristi se GTKWave.

Prije vizuelizacije se izvršava naredba:

```
ghdl -r or_gate --vcd=prviTest_vcd.vcd
```

da bi se dobio vcd fajl.

Nakon toga naredbu:

```
gtkwave prviTest_vcd.vcd
```

za vizuelizaciju.

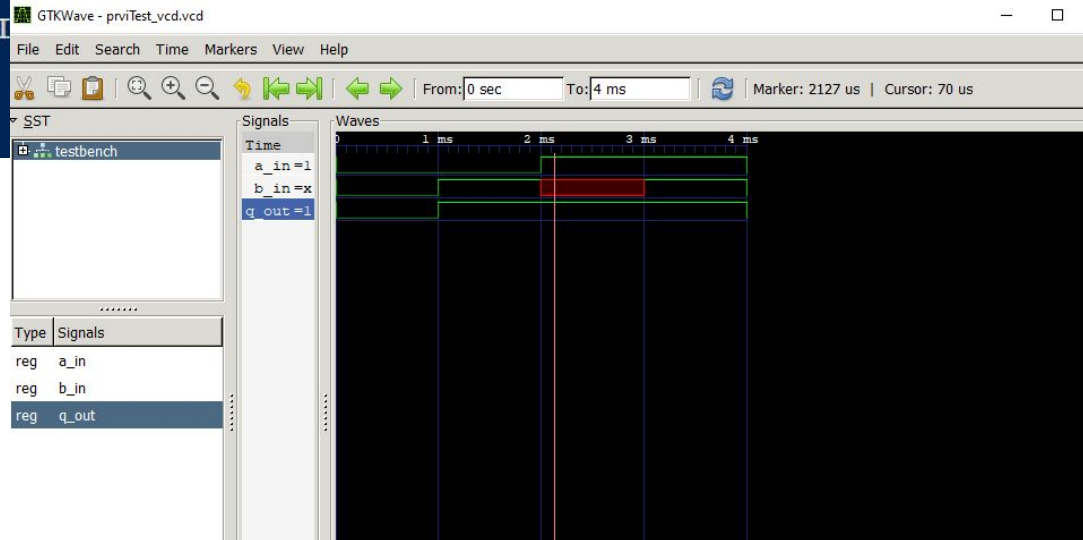
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Windows PowerShell

```
PS E:\Ghdl\GHDL_soft\prviTest> ghdl -a prviTest.vhdl
PS E:\Ghdl\GHDL_soft\prviTest> ghdl -a prviTestTestbench.vhdl
PS E:\Ghdl\GHDL_soft\prviTest> ghdl -e tb
E:\Ghdl\GHDL_soft\GHDL\0.37-mingw32-mcode\bin\ghdl.exe: cannot find entity or configuration tb
PS E:\Ghdl\GHDL_soft\prviTest> ghdl -e or_gate
PS E:\Ghdl\GHDL_soft\prviTest> ghdl -r testbench --vcd=prviTest_vcd.vcd
prviTestTestbench.vhdl:50:5:@4ms: (assertion note): Test done.
PS E:\Ghdl\GHDL_soft\prviTest> gtkwave prviTest_vcd.vcd
```

GTKWave Analyzer v3.3.100 (w)1999-2019 BSI

```
[0] start time.
[4000000000000] end time.
```



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