GPU nodes in Tetralith

NAISS

HARDWARE:

- 170 retrofitted thin nodes
- 96 GiB of primary memory (RAM)
- One NVIDIA Tesla T4 GPU (Turing)
- One NVMe SSD scratch disk of ~2TiB

Further reading: www.nsc.liu.se/systems/tetralith/

TESLA T4 SPECIFICATIONS:

compute capability	7.5
tensor cores	320
CUDA cores	2560
single precision performance	8.1 TFLOPS
memory	16 GB
power	70 W

PRIMARILY SUITABLE FOR:

- Machine learning
- Single precision FP (*e.g.* MD)
- Hardware accelerated graphics

Available to all projects with allocations on Tetralith!

ALLOCATING A GPU NODE

Using `interactive`:

```
[x_torra@tetralith2]$ interactive -n 1 -c 32 --gpus-per-task=1 -t 60 -A naiss2024-5-11 --reservation=now
salloc: Pending job allocation 22767410
salloc: job 22767410 queued and waiting for resources
salloc: job 22767410 has been allocated resources
salloc: Granted job allocation 22767410
salloc: Waiting for resource configuration
salloc: Nodes n86 are ready for job
[x_torra@n86]$
```

`-n 1 -c 32` or (`-N 1`)

Allocate a complete compute node

`--gpus-per-task=1` or (`--gpus=1`)

Allocates the GPU

`-A "slurm account"`

Only needed if you are included in several projects

`--reservation=now`

Is for short (*max* 60 min.) jobs

Don't use for longer jobs!

> *Always allocate a full compute node when using a GPU on Tetralith!*

ALLOCATING A GPU NODE

Batch script header:

```
#!/bin/bash

#SBATCH --ntasks=1
#SBATCH --cpus-per-task=32
#SBATCH --gpus-per-task=1
#SBATCH --time=24:00:00
#SBATCH --account=naiss2024-5-11
⋮
```

Here I've used long options (*e.g.* `--ntasks=1`), but short options (*e.g.* `-n 1`) also work!

Further reading: www.nsc.liu.se/support/systems/tetralith-GPU-user-guide/

```
[x_torra@tetralith2]$ interactive -n 1 -c 32 --gpus-per-task=1 -t 60 --reservation=now
salloc: Pending job allocation 33885382
salloc: job 33885382 queued and waiting for resources
salloc: job 33885382 has been allocated resources
salloc: Granted job allocation 33885382
salloc: Waiting for resource configuration
salloc: Nodes n74 are ready for job
[x_torra@n74]$ nvidia-smi
Mon Apr 22 15:13:28 2024
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 550.54.14              Driver Version: 550.54.14      CUDA Version: 12.4     |
|-----------------------------------------+------------------------+----------------------+
| GPU  Name                 Persistence-M | Bus-Id          Disp.A | Volatile Uncorr. ECC |
| Fan  Temp   Perf          Pwr:Usage/Cap |           Memory-Usage | GPU-Util  Compute M. |
|                                         |                        |               MIG M. |
|=========================================+========================+======================|
|   0  Tesla T4                       On  |   00000000:3B:00.0 Off |                    0 |
| N/A   29C    P8              9W /   70W |       0MiB /  15360MiB |      0%      Default |
|                                         |                        |                  N/A |
+-----------------------------------------+------------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                                  |
|  GPU   GI   CI        PID   Type   Process name                  GPU Memory |
|        ID   ID                                                   Usage      |
|=============================================================================|
|  No running processes found                                                 |
+-----------------------------------------------------------------------------+
```

ALLOCATING A GPU NODE FOR GRAPHICS

1. Login with ThinLinc!
2. Allocate a GPU node using `interactive.vgl`
3. Launch GUI with `vglrun gui_name`

```
[x_torra@tetralith2]$ interactive.vgl -t 60 --reservation=now
Enabling VirtualGL mode.
Adding --exclusive option. Note: your project will be charged for full nodes!
Adding --constraint=virtualgl to enable VirtualGL.
Adding --gres=gpu to allocate GPU to job.
Allocating one GPU for the interactive shell to allow accelerated graphics. Note: GPU will not be available from e.g job st
Remember to use "vglrun <application>" to enable accelerated graphics for <application>.
salloc: Pending job allocation 33885503
salloc: job 33885503 queued and waiting for resources
salloc: job 33885503 has been allocated resources
salloc: Granted job allocation 33885503
salloc: Waiting for resource configuration
salloc: Nodes n73 are ready for job
[x_torra@n73]$
```

Further reading: www.nsc.liu.se/support/graphics/

torbenr@tetralith2.nsc.liu.se - ThinLinc Client

Applications | MATLAB R2020b - acad... | Terminal - torbenr@n99... | 19:51 | Torben Rasmussen

Trash

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Terminal - torbenr@n99: ~

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```
**** Useful commands
To see your active projects and CPU time usage: projinfo
To see available disk storage and usage: snicquota
To see your last jobs: lastjobs
Login to compute node to check running job: jobsh

To tweak job priorities, extend timelimits and reserve nodes: see
https://www.nsc.liu.se/support/batch-jobs/boost-tools/

(Run "nsc-mute-login" to not show this information)

**** Important information (expires 2020-12-17):
The Tetralith "devel" nodes now have GPUs. In addition to testing
normal applications, you can now use these for short tests of GPU
applications or accelerating graphical interfaces using VirtualGL.

Read more at:
- https://www.nsc.liu.se/support/systems/tetralith-GPU-user-guide/
- https://www.nsc.liu.se/support/graphics/
- https://lists.nsc.liu.se/mailman/public/tetralith-users/2020-Octo

[torbenr@tetralith2 ~]$ interactive.vgl -N 1 -t 60 -A nsc --reserva
Enabling VirtualGL mode.
Adding --exclusive option. Note: your project will be charged for f
Adding --constraint=virtualgl to enable VirtualGL.
Adding --gres=gpu to allocate GPU to job.
Allocating one GPU for the interactive shell to allow accelerated g
.g job steps launched by srun
Remember to use "vglrun <application>" to enable accelerated graphi
salloc: Pending job allocation 11193190
salloc: job 11193190 queued and waiting for resources
salloc: job 11193190 has been allocated resources
salloc: Granted job allocation 11193190
srun: Step created for job 11193190
[torbenr@n99 ~]$ module load MATLAB/R2020b-nsc1
[torbenr@n99 ~]$ vglrun matlab -nosoftwareopengl
```

MATLAB R2020b - academic use

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Search Documentation | Torben

New | Open | Save | Find Files | Compare | Print | Go To | Find | Text | Normal | Code | Task | Control | Refactor | Run Section | Section Break | Run and Advance | Run to End | Run | Step | Stop

FILE | NAVIGATE | TEXT | CODE | SECTION | RUN

/ ▸ proj ▸ nsc ▸ users ▸ torbenr ▸ jobs ▸ matlab ▸

Current Folder

Name

- CardiacMRI-master
- ClassifyECGSignals
- Parasitology
- Archive.zip

Details

Select a file to view detai

Live Editor - /proj/nsc/users/torbenr/jobs/matlab/CardiacMRI-master/Part02_Modeling.mlx

Part02_Modeling.mlx

Semantic Segmentation Transfer Learning

We are now ready to actually train our network. Let's set up some training options and get to work. Our network was trained on four NVIDIA® V100 Tensor Core GPUs on the cloud, taking approximately one hour of training time.

```
64  if doTraining
65      options = trainingOptions('sgdm', ...
66          'Momentum', 0.9, ...
67          'InitialLearnRate', 0.0002, ...
68          'L2Regularization', 0.0005, ...
69          'MaxEpochs', 100, ...
70          'MiniBatchSize', 4, ...
71          'Shuffle', 'every-epoch', ...
72          'VerboseFrequency', 100,...
73          'ValidationData',valds,...
74          'ValidationPatience',5,...
75          'Plots','training-progress',...
76          'ExecutionEnvironment','gpu');
77      tic
78      [net, info] = trainNetwork(trainds,lgraph,options);
79      toc
80  else
81      imshow(fullfile(prj.RootFolder,"HelperFunctions","Images","SegnetTrainingProgressPlot.png"))
82  end
```

```
Initializing input data normalization.
|=========================================================================================================|
|  Epoch  |  Iteration  |  Time Elapsed  |  Mini-batch  |  Validation  |  Mini-batch  |  Validation  |  Base Learning  |
|         |             |   (hh:mm:ss)   |   Accuracy   |   Accuracy   |     Loss     |     Loss     |      Rate       |
|=========================================================================================================|
|       1 |           1 |       00:00:28 |       63.13% |       63.11% |       0.9535 |       0.9476 |          0.0002 |
|       1 |          50 |       00:01:02 |       63.59% |       63.27% |       0.9687 |       0.9473 |          0.0002 |
|       1 |         100 |       00:01:34 |       63.25% |       63.47% |       0.9245 |       0.9468 |          0.0002 |
|       1 |         150 |       00:02:07 |       63.98% |       63.62% |       0.9672 |       0.9466 |          0.0002 |
|       2 |         200 |       00:02:38 |       64.04% |       63.79% |       0.9513 |       0.9463 |          0.0002 |
|       2 |         250 |       00:03:11 |       63.65% |       63.94% |       0.9282 |       0.9461 |          0.0002 |
|       2 |         300 |       00:03:43 |       63.92% |       64.08% |       0.9314 |       0.9459 |          0.0002 |
|       3 |         350 |       00:04:15 |       64.06% |       64.19% |       0.9385 |       0.9458 |          0.0002 |
|       3 |         400 |       00:04:48 |       64.23% |       64.32% |       0.9356 |       0.9456 |          0.0002 |
|       3 |         450 |       00:05:20 |       64.34% |       64.45% |       0.9456 |       0.9455 |          0.0002 |
|       4 |         500 |       00:05:52 |       64.27% |       64.56% |       0.9270 |       0.9454 |          0.0002 |
```

Command Window

New to MATLAB? See resources for Getting Started.

>>

Workspace

Name	Value
ans	1x1 struct

Ready | UTF-8 | script | Ln 83 | Col 1

torbenr@tetralith2.nsc.liu.se - ThinLinc-klient

Applications | PyMOL | Terminal - torbenr@n73:... | 2024-04-22 15:47 | Torben Rasmussen

Trash

File System

Home

Terminal - torbenr@n73: ~

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```
   PyMOL/2.3.0-1-PReSTO                    PyMOL/2.5.0-PReSTO-9.0    PyMOL/2.5.0-1-PReSTO      PyMOL/2.5.0-5-PReSTO
   PyMOL/2.3.0-2-PReSTO                    PyMOL/2.5.0-PReSTO-9.4    PyMOL/2.5.0-2-PReSTO      PyMOL/2.5.0-7-PReSTO
   PyMOL/2.5.0-PReSTO-toolchain-foss-2021a PyMOL/2.5.0-PReSTO-9.6    PyMOL/2.5.0-3-PReSTO

------------------------------------------ /software/sse2/tetralith_el9/modules -------------------------------------------
   PyMOL/recommendation (D)    PyMOL/2.5.0-hpc1-gcc-2022a-eb

  Where:
   D:  Default Module
[torbenr@n73 ~]$ module load PyMOL/2.5.0-hpc1-gcc-2022a-eb
[torbenr@n73 ~]$ pymol
Executing 'vglrun pymol.real'
QStandardPaths: XDG_RUNTIME_DIR not set, defaulting to '/tmp/r
 PyMOL(TM) Molecular Graphics System, Version 2.5.0.
 Copyright (c) Schrodinger, LLC.
 All Rights Reserved.

    Created by Warren L. DeLano, Ph.D.

    PyMOL is user-supported open-source software.  Although so
    are freely available, PyMOL is not in the public domain.

    If PyMOL is helpful in your work or study, then please vol
    support for our ongoing efforts to create open and afforda
    software by purchasing a PyMOL Maintenance and/or Support

    More information can be found at "http://www.pymol.org".

    Enter "help" for a list of commands.
    Enter "help <command-name>" for information on a specific

Hit ESC anytime to toggle between text and graphics.

Detected OpenGL version 4.6. Shaders available.
Detected GLSL version 4.60.
OpenGL graphics engine:
 GL_VENDOR:   NVIDIA Corporation
 GL_RENDERER: Tesla T4/PCIe/SSE2
 GL_VERSION:  4.6.0 NVIDIA 550.54.14
Detected 32 CPU cores.  Enabled multithreaded rendering.

CmdLoad: "" loaded as "apoa1".
```

PyMOL (on n73)

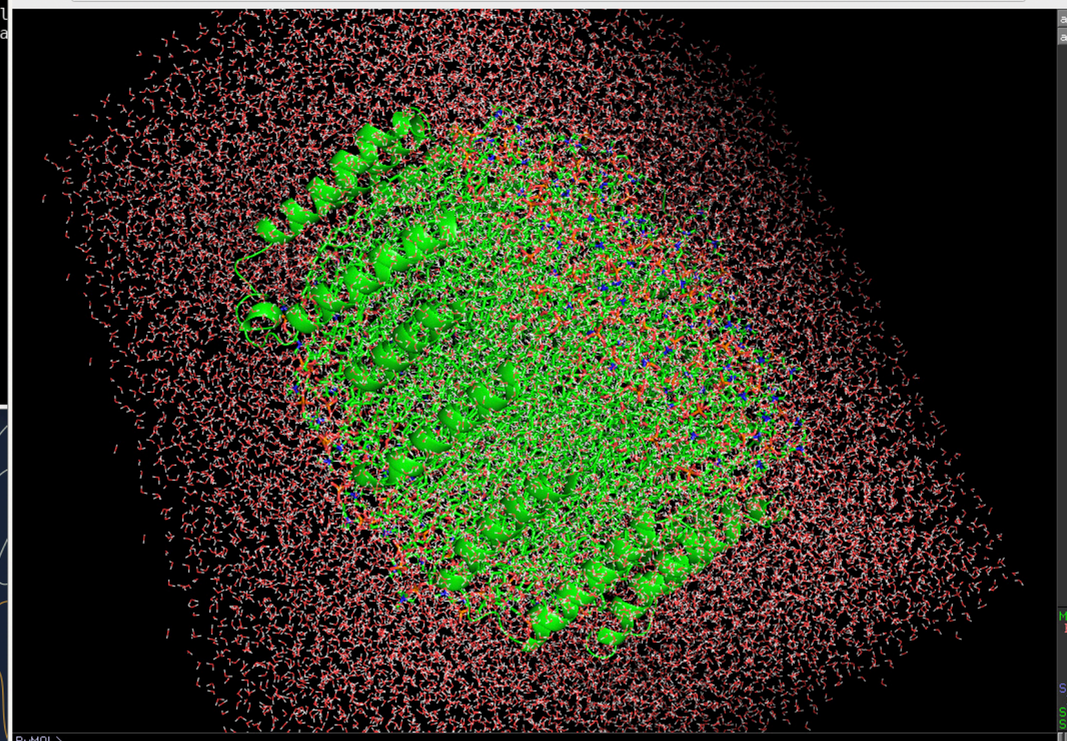
File Edit Build Movie Display Setting Scene Mouse Wizard Plugin Help

```
Detected GLSL version 4.60.
OpenGL graphics engine:
 GL_VENDOR:   NVIDIA Corporation
 GL_RENDERER: Tesla T4/PCIe/SSE2
 GL_VERSION:  4.6.0 NVIDIA 550.54.14
Detected 32 CPU cores.  Enabled multithreaded rendering.

CmdLoad: "" loaded as "apoa1".
```

Reset Zoom Orient Draw/Ray
Unpick Deselect Rock Get View
|< < Stop Play > >| MClear
Builder Properties Rebuild

PyMOL>



all A S H L C
apoa1 1/1 A S H L C

```
Mouse Mode 3-Button Viewing
 Buttons  L    M    R  Wheel
  & Keys Rota Move MovZ Slab
    Shft +Box -Box Clip MovS
    Ctrl Move PkAt Pk1  MvSZ
    CtSh Sele Orig Clip MovZ
SnglClk +/-  Cent Menu
 DblClk Menu   -  PkAt
Selecting Residues
State    1/   1
```

PyMOL>_

USING SINGULARITY/APPTAINER AND NGC

NGC Catalog: Software Hub with containers with a range of GPU-accelerated software for NVIDIA GPUs

```
[torbenr@tetralith1]$ interactive -n 1 -c 32 --gpus-per-task=1 -t 60 --reservation=now
salloc: Pending job allocation 22784449
salloc: job 22784449 queued and waiting for resources
salloc: job 22784449 has been allocated resources
salloc: Granted job allocation 22784449
salloc: Waiting for resource configuration
salloc: Nodes n1130 are ready for job
[torbenr@n1130]$ export APPTAINER_BIND="/proj,/scratch/local,/software:/software:ro"
[torbenr@n1130]$ apptainer run --nv tf20.09_py3.v3.sif
Usage example: change_mofed_version.sh 4.5-1.0.1

================
== TensorFlow ==
================

NVIDIA Release 20.09-tf2 (build 16003717)
TensorFlow Version 2.3.0

Container image Copyright (c) 2020, NVIDIA CORPORATION.  All rights reserved.
Copyright 2017-2020 The TensorFlow Authors.  All rights reserved.

Various files include modifications (c) NVIDIA CORPORATION.  All rights reserved.
NVIDIA modifications are covered by the license terms that apply to the underlying project or file.

Detected MOFED .

Singularity>
```

Use the python environment in the container:

```
Singularity> jupyter-notebook --no-browser --ip=n1130
2022-11-15 14:37:00.421476: I tensorflow/stream_executor/platform/default/dso_loader.cc:49] Successfully opened dynamic lib
[I 14:37:03.099 NotebookApp] jupyter_tensorboard extension loaded.
[I 14:37:03.494 NotebookApp] JupyterLab extension loaded from /usr/local/lib/python3.6/dist-packages/jupyterlab
[I 14:37:03.494 NotebookApp] JupyterLab application directory is /usr/local/share/jupyter/lab
[I 14:37:03.712 NotebookApp] [Jupytext Server Extension] NotebookApp.contents_manager_class is (a subclass of) jupytext.Tex
[I 14:37:03.714 NotebookApp] Serving notebooks from local directory: /proj/nsc/users/torbenr/jobs/ngc
[I 14:37:03.714 NotebookApp] The Jupyter Notebook is running at:
[I 14:37:03.714 NotebookApp] http://n1130:8900/?token=a39669f6c2e66a0e02e98be791ef9ce042346d15e755ac3d
[I 14:37:03.714 NotebookApp]  or http://127.0.0.1:8900/?token=a39669f6c2e66a0e02e98be791ef9ce042346d15e755ac3d
[I 14:37:03.714 NotebookApp] Use Control-C to stop this server and shut down all kernels (twice to skip confirmation).
[C 14:37:03.801 NotebookApp]

    To access the notebook, open this file in a browser:
        file:///home/torbenr/.local/share/jupyter/runtime/nbserver-195427-open.html
    Or copy and paste one of these URLs:
        http://n1130:8900/?token=a39669f6c2e66a0e02e98be791ef9ce042346d15e755ac3d
     or http://127.0.0.1:8900/?token=a39669f6c2e66a0e02e98be791ef9ce042346d15e755ac3d
```

torbenr@tetralith1.nsc.liu.se - ThinLinc Client

Applications | 01_Notebook_Neural_N... | Terminal - torbenr@n11... | Terminal - torbenr@tetr... | 14:39 | Torben Rasmussen

Terminal - torbenr@n1130: ngc

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```
Container image Copyright (c) 2020, NVIDIA CORPORATION.  All rights reserved.
Copyright 2017-2020 The TensorFlow Authors.  All rights reserved.

Various files include modifications (c) NVIDIA CORPORATION.  All rights reserved.
NVIDIA modifications are covered by the license terms that apply to the underlying project or file.

Detected MOFED .

Singularity> jupyter-notebook --no-browser --ip=n1130
2022-11-15 14:37:00.421476: I tensorflow/stream_executor/platform/default/dso_loader.cc:49] Successfully opene
d dynamic library libcudart.so.11.0
[I 14:37:03.099 NotebookApp] jupyter_tensorboard extension loaded.
[I 14:37:03.494 NotebookApp] JupyterLab extension loaded from /usr/local/lib/python3.6/dist-packages/jupyterla
b
[I 14:37:03.494 NotebookApp] JupyterLab application directory is /usr/local/share/jupyter/lab
[I 14:37:03.712 NotebookApp] [Jupytext Server Extension] NotebookApp.contents_manager_class is (a subclass of)
 jupytext.TextFileContentsManager already - OK
[I 14:37:03.714 NotebookApp] Serving notebooks from local directory: /proj/nsc/users/torbenr/jobs/ngc
[I 14:37:03.714 NotebookApp] The Jupyter Notebook is running at:
[I 14:37:03.714 NotebookApp] http://n1130:8900/?token=a39669f6c2e66a0e02e98be791ef9ce042346d15e755ac3d
[I 14:37:03.714 NotebookApp]  or http://127.0.0.1:8900/?token=a39669f6c2e66a0e02e98be791ef9ce042346d15e755ac3d
[I 14:37:03.714 NotebookApp] Use Control-C to stop this server and shut down all kernels (twice to skip confir
mation).
[C 14:37:03.801 NotebookApp]

    To access the notebook, open this file in a browser:
        file:///home/torbenr/.local/share/jupyter/runtime/nbserver-195427-open.html
    Or copy and paste one of these URLs:
        http://n1130:8900/?token=a39669f6c2e66a0e02e98be791ef9ce042346d15e755ac3d
     or http://127.0.0.1:8900/?token=a39669f6c2e66a0e02e98be791ef9ce042346d15e755ac3d
[I 14:38:34.347 NotebookApp] 302 GET /?token=a39669f6c2e66a0e02e98be791ef9ce042346d15e755ac3d (10.24.254.11) 2
.62ms
[I 14:38:47.394 NotebookApp] 302 GET /notebooks/Lab1/images/DLI_Header.png (10.24.254.11) 3.58ms
[I 14:38:48.059 NotebookApp] 302 GET /notebooks/Lab1/images/SGD1.png (10.24.254.11) 4.14ms
[I 14:38:48.074 NotebookApp] 302 GET /notebooks/Lab1/images/SGD2.png (10.24.254.11) 3.94ms
[I 14:38:48.091 NotebookApp] 302 GET /notebooks/Lab1/images/SGD3.png (10.24.254.11) 4.02ms
[I 14:38:48.681 NotebookApp] Kernel started: 59f51f23-a5a7-4ca4-8eb5-5ae1a1197c30
2022-11-15 14:39:10.966216: I tensorflow/stream_executor/platform/default/dso_loader.cc:49] Successfully opene
d dynamic library libcudart.so.11.0
```

01_Notebook_Neural_Network_Optimization - Jupyter Notebook — Mozilla Firefox

Running graphical applic | Lab1/ | 01_Notebook_Neural_Net

n1130:8900/notebooks/Lab1/01_Notebook_Neural_Network_Optimization.ipynb

jupyter 01_Notebook_Neural_Network_Optimization Last Checkpoint: 12/02/2020 (unsaved changes) Logout

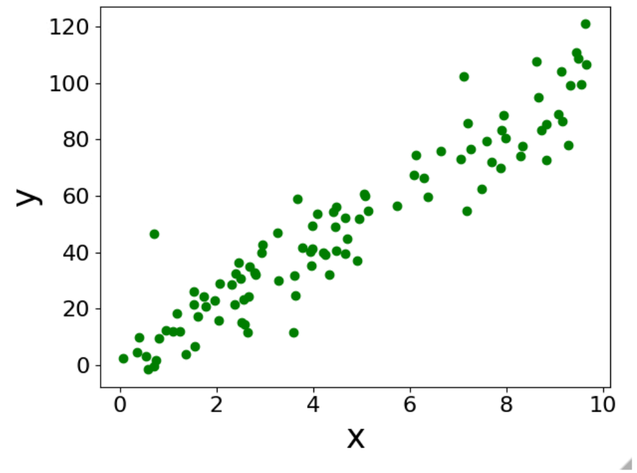
File Edit View Insert Cell Kernel Widgets Help Trusted Python 3

Run Markdown

In [3]:
```
# This section generates the training dataset as defined by the variables in the section above.
x = np.random.uniform(0, 10, n_samples)
y = np.array([w_gen * (x + np.random.normal(loc=mean_gen, scale=std_gen, size=None)) + b_gen for x in x])
```

In [4]:
```
# Plot our randomly generated dataset
plt.close()
plt.plot(x, y, 'go')
plt.xlabel("x", size=24)
plt.ylabel("y", size=24)
plt.tick_params(axis='both', labelsize=16)
plt.tight_layout()
plt.show()
```

Figure 1



Defining the model

Regardless of the complexity of the machine learning problem the process of code development consists of:

- Creating a definition of the model
- Defining the loss (cost) function that will guide our training process. The loss function is effectively a definition of success that informs our optimization

Building an Apptainer container from an NGC Docker image:

```
[torbenr@tetralith1]$ interactive -n 1 -c 32 --gpus-per-task=1 -t 60 --reservation=now
⋮
[torbenr@n1112]$ cat ngc_sourceme.txt
export SINGULARITY_DOCKER_USERNAME='$oauthtoken'
export SINGULARITY_DOCKER_PASSWORD="long-pw-private-string"
export APPTAINER_BIND="/proj,/scratch/local,/software:/software:ro"
[torbenr@n1112]$ . ./ngc_sourceme.txt
[torbenr@n1112]$ apptainer build tf20.09_py3.sif docker://nvcr.io/nvidia/tensorflow:20.09-tf2-py3
⋮
Copying blob 1fa632a1a9de done   |
Copying config eb8a6351c4 done   |
Writing manifest to image destination
2024/04/22 17:49:24  info unpack layer: sha256:f08d8e2a3ba11bea23cf5c17e8e1c620057412ed05c32d1114640e18d6dd0a43
2024/04/22 17:49:25  info unpack layer: sha256:3baa9cb2483bd9c5329a44d9c2fe72535625bbd4308bca95785dd58e72c06365
⋮
2024/04/22 17:50:55  info unpack layer: sha256:1fa632a1a9de2caa795450e3871396931851e848d11a227f18e10592a409ffb0
INFO:    Creating SIF file...
INFO:    Build complete: tf20.09_py3.v4.sif
[torbenr@n1112]$ apptainer run --nv tf20.09_py3.sif
Singularity>
```

Monitoring GPU usage:

```
[torbenr@tetralith1]$ interactive -N 1 --gpus=1 -t 60 --reservation=now
⋮
[torbenr@n75]$ tmux
# ^b c
[torbenr@n75]$ apptainer run --nv -B $PWD:/host_pwd --pwd /host_pwd relion_3.1.3.sif ./ngc_run_relion.sh
# ^b 0
[torbenr@n75]$ nvidia-smi
Mon Apr 24 15:17:39 2023
+-----------------------------------------------------------------------------+
| NVIDIA-SMI 515.105.01   Driver Version: 515.105.01   CUDA Version: 11.7     |
|-------------------------------+----------------------+----------------------+
| GPU  Name        Persistence-M| Bus-Id        Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|         Memory-Usage | GPU-Util  Compute M. |
|                               |                      |               MIG M. |
|===============================+======================+======================|
|   0  Tesla T4            On   | 00000000:3B:00.0 Off |                    0 |
| N/A   40C    P0    34W /  70W |    233MiB / 15360MiB |      0%      Default |
|                               |                      |                  N/A |
+-------------------------------+----------------------+----------------------+

+-----------------------------------------------------------------------------+
| Processes:                                                                  |
|  GPU   GI   CI        PID   Type   Process name                  GPU Memory |
|        ID   ID                                                   Usage      |
|=============================================================================|
|    0   N/A  N/A     66383      C   relion_refine_mpi                 103MiB |
|    0   N/A  N/A     66384      C   relion_refine_mpi                 103MiB |
|    0   N/A  N/A     66392      C   nvidia-cuda-mps-server             23MiB |
+-----------------------------------------------------------------------------+
```

Monitoring GPU usage: (load)

```
[torbenr@n75]$ nvidia-smi dmon
# gpu   pwr gtemp mtemp    sm   mem   enc   dec  mclk  pclk
# Idx     W     C     C     %     %     %     %   MHz   MHz
    0    68    67     -    94     1     0     0  5000  1155
    0    71    67     -    83     1     0     0  5000  1230
    0    67    67     -    87     1     0     0  5000  1170
    0    69    67     -    94     1     0     0  5000  1170
    0    68    67     -    93     1     0     0  5000  1155
    0    65    67     -    94     1     0     0  5000  1155
    0    69    67     -    81     1     0     0  5000  1200
    0    71    67     -    95     1     0     0  5000  1140
    0    72    67     -    89     1     0     0  5000  1140
    0    65    67     -    94     1     0     0  5000  1140
    0    70    67     -    93     1     0     0  5000  1170
    0    69    67     -    93     1     0     0  5000  1185
⋮
```