CS 638/838 LAB3

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OUTLINE

1. Data Set
2. Code Skeleton
3. Requirements
4. Suggestions

next

01

DATA SET

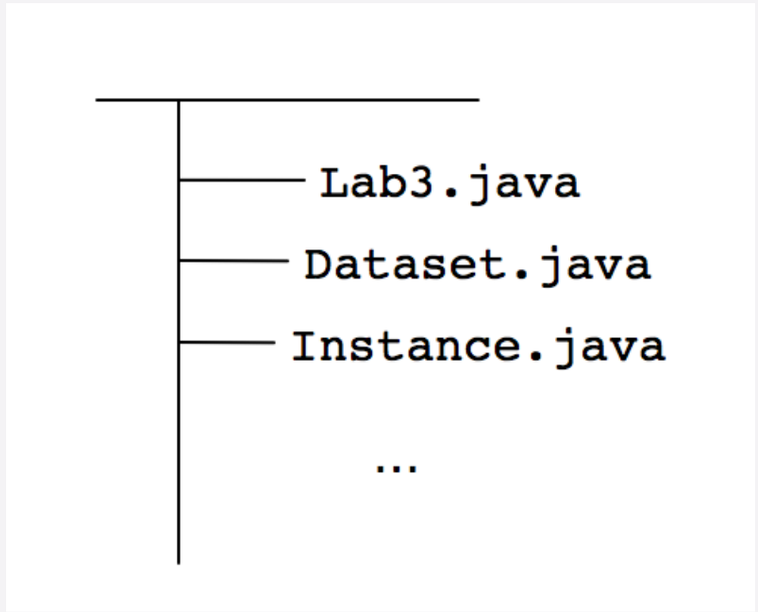
- Includes 912 images (from http://www.vision.caltech.edu/Image_Datasets/Caltech101/)
- Down-sampled to 128 * 128
- Classified into 6 categories
- Image files (in three subdirs) are named in format:

  label_image_XXXX (4 digits)

02

CODE SKELETON

- Code and data (zipped here) on line
- Code hierarchy



- Lab3.java (main function)
  - Loads in the image as Instance object
  - Stores all image instances in the dataset
- Dataset.java
  - Stores all image instances as a list in the dataset
- Instance.java
  - Provides the methods to separate RGB channels in the image
  - Provides the method to change image into grey-scale image

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CODE SKELETON

Lab3.java

- Void main()
- Converts images to (1D) ‘fixed length feature vectors’

Instance.java

- BufferedImage image
- String label
- int width, height
- 2D matrix with separate RGB channels
- Gray-scale images; you choose if you wish to use RGB or grey scale
- FOUR 2D matrices in total: R + G + B + Grey
- Each matrix element an int in [0, 255]

Dataset.java

- void add(Instance image)
- List<Instance> getImages()

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REQUIREMENTS

- See Day 1 ‘course overview’ slides for required network structure
- Only edit Lab3.java (we will load the other provided files during testing – do NOT edit them! We will fix any bugs, announce, and update files)
- Lab3.java should read in UP TO FOUR strings: the name of the *train*, *tune*, and *test* directories plus *imageSize* *(details later)*
- For each of the six categories, we already put the 5th example in TUNE and 6th in TEST (rest in TRAIN)

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REQUIREMENTS

- Use DROPOUT (50% of weights)
- Use ReLU for hiddens and the six output nodes
- How many HUs per layer?

  Up to you

  See how fast your code runs, discuss in Piazza

- Use early stopping to reduce overfitting
- Max number of epochs?

  Whatever is feasible

  Discuss in Piazza as you run experiments

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REQUIREMENTS

- Probably test-set accuracy will be poor ☹
- Learning curve (later) will give us sense if more data would help
- Optional Experiment 1: alter the provided TRAIN images to create more examples
  - Shift a little, change colors?, etc
  - Post links to scientific papers on ideas in the literature
- Optional Experiment 2: try more layers

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WHAT TO OUTPUT

- Your code should output (in plain ASCII) a CONFUSION MATRIX (see below)
- Each TEST SET example increments the count in ONE CELL
- Also report overall testset accuracy

CORRECT Category

PREDICTED Cat

	Flower	Star Fish	Watch	Piano	Airplane	Butterfly
Flower						
Star Fish						
Watch						
Piano						
Airplane						
Butterfly						

PERCEPTRON TESTSET RESULTS (WITH DROP OUT)

CORRECT Category

PREDICTED Cat	airplanes	butterfly	flower	grand_piano	starfish	watch	
airplanes	36	2	1	1	1	1	row SUM = 42
butterfly	0	6	3	0	3	2	row SUM = 14
flower	0	2	28	2	4	3	row SUM = 39
grand_piano	0	0	0	13	0	0	row SUM = 13
starfish	1	5	2	1	4	2	row SUM = 15
watch	4	3	3	2	5	38	row SUM = 55
column SUM	41	18	37	19	17	46	

total examples = 178, errors = 53 (29.8%)

Used FOUR input units per pixel (red + blue + green + grey)

Trained SIX perceptrons, **100%** TRAIN accuracy after about 50 epochs (used early stopping)

Trained EACH as a BINARY CLASSIFIER (eg, *watch* vs. *not_watch*)

But when PREDICTING used perceptron with largest weighted sum

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EXPERIMENT

- Create and discuss a **learning curve**

  Plot TEST and maybe TUNE ERROR RATES as function of # of training examples

- Train on 25%, 50%, 75%, and 100% of the train examples (if your code is fast enough, create more points on the learning curve)

- Use SAME TUNE AND TEST for all points on learning curve (if feasible, multiple times sample the trainset and plot mean)

- The code you submit for our testing should use 100% of the training examples

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PERCEPTRON LEARNING CURVE

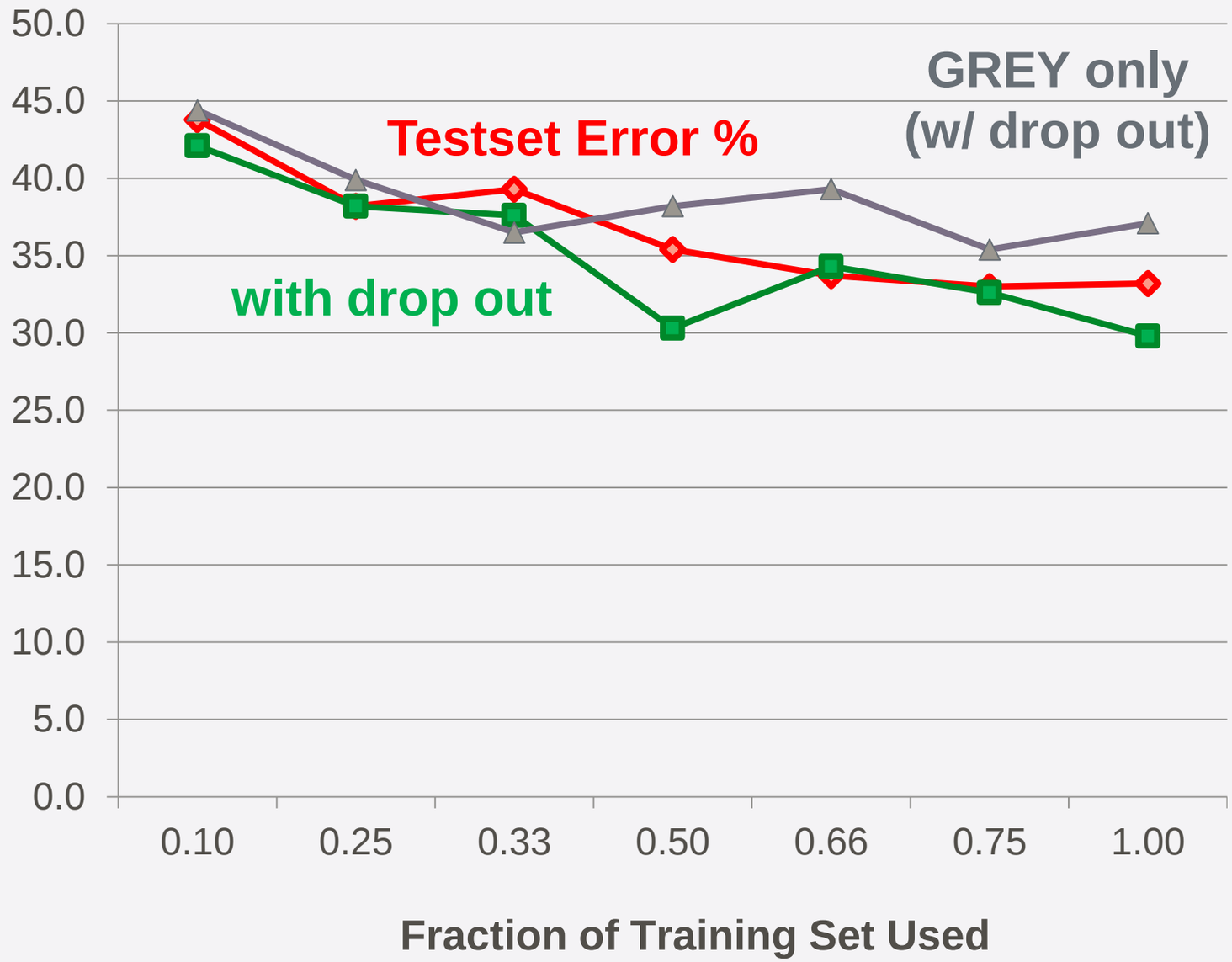

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IMAGE SIZE

- Raw images are 128x128
- We provide code for re-sizing
- Some **perceptron** test-set error rates

8x8	**41%**	**(46% grey only)**
16x16	**33%**	**(39%)**
32x32	**31%**	**(36%)**
64x64	**31%**	**(35%)**
128x128	**30%**	**(33%)**

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ONE-LAYER HIDDEN UNITS

- Used 250 HUs, 1000 epochs, dropout wgts
- Not doing as well as perceptrons; why?

8x8: 48% error rate on testset

16x16: 58% (46% GREY only)

32x32: (47% GREY only)

- Training slow; still debugging

  - will post more stats later

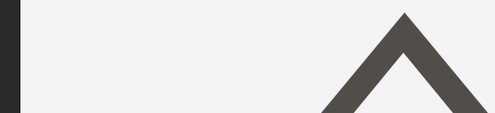
  - will start on convolution-net soon

04

SUGGESTIONS

- You might want to try using your Lab 1 and/or Lab 2 code first!
  - get everything to work, then add layers
  - nice 'baseline' system to evaluate value of DEEP

- First get training to work and report errors
- Next create confusion matrix on train set
- After that create confusion matrices on tune and test sets (use test=train to debug)
- Add 'drop out' next
- Then incorporate early-stopping code
- Finally allow using a fraction of TRAIN to generate the 'learning curve' (permute, then copy first *N* items)



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DROPOUT TIPS

1. Need to remember which weights are ‘dropped out’ during forward prop, so they are also ignored during back prop

   Boolean[] dropOutMask = (*dropoutRate > 0.0 ?* ***new Boolean[inputVectorSize] : null);***

2. Remember on TUNE and TEST examples, to multiply all weights by (1 – *dropoutRate)* so average weighted sum is the same as during training

3. I never dropped out the weight rep’ing the BIAS (so didn’t multiply by *1-dropoutRate*)

4. Ideally would do *multiple measurements* per plotted point since random numbers used

Enjoy it! ☺