Programing Assignement 1: Resnet

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1. Resnet on CIFAR10

In this section, I will introduce the implementation details and comparison between training from scratch and training with fine-tuning.

1.1. Network Architecture

For this classification task, I use Resnet34 as the backbone and modified two layers to fit the input image size and the number of classes. The detailed modifications are as follows:

- Change the first convolution layer from 7×7 kernel with stride 2 to 3×3 kernel with stride 1.
- Change the final fully-connected layer from 1000 output to 10 output.

1.2. Global Training Settings

1.2.1 Dataset split

The original CIFAR10 dataset contains 60000 images with size 32×32 with 50000 for training and 10000 for testing.

Given that it doesn't naturally split the validation set, I randomly choose 5000 images from the training set as the validation set with a fixed seed.

1.2.2 Data Augmentation

In order to increase the robustness and generalization of the model, I use random horizontal flip and random crop with zero padding as augmentation methods.

1.3. Training from scratch

1.3.1 Training details

The hyperparameters settings follow the detail of [1], which are listed as follows:

- learning rate: 0.1
- learning rate decay: decay 0.1 after 32k and 48k iterations.

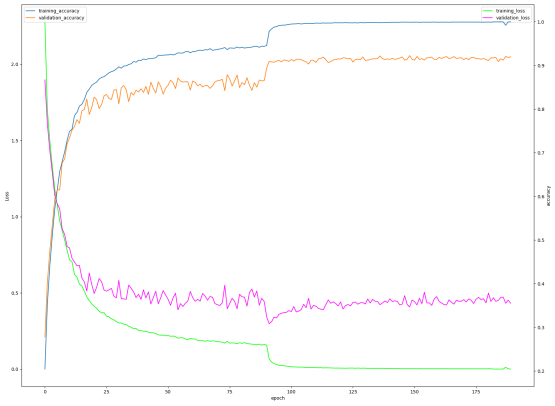

Figure 1. Training curve of Resnet34 on CIFAR10

- batch size: 128

Moreover, I used *Cross Entropy loss* as loss function and used classification accuracy as metric

1.3.2 Experimental results

After 200 epoch training, the average classification accuracy is **91.31**% under test set. The training curve are shown as Figure1

1.4. Training from Fine-tuning

Since I used *Resnet*34 as backbone, I can directly load the pretrained weight of *Resnet*34 trained on *ImageNet*.

1.4.1 Training Policy

Given that I only changed the first and the last of layer of *Resnet*34, I choose *semi-freezing training* policy to fine-tune.

1.5. The ruler

The LaTeX style defines a printed ruler which should be present in the version submitted for review. The ruler is provided in order that reviewers may comment on particular lines in the paper without circumlocution. If you are preparing a document using a non-LaTeX document preparation system, please arrange for an equivalent ruler to appear on the final output pages. The presence or absence of the ruler should not change the appearance of any other content on the page. The camera-ready copy should not contain a ruler. (LaTeX users may use options of cvpr.sty to switch between different versions.)

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Make sure that the Paper ID from the submission system is visible in the version submitted for review (replacing the "*****" you see in this document). If you are using the LaTeX template, make sure to update paper ID in the appropriate place in the tex file.

1.7. Mathematics

Please number all of your sections and displayed equations as in these examples:

$$E = m \cdot c^2 \tag{1}$$

and

$$v = a \cdot t. \tag{2}$$

It is important for readers to be able to refer to any particular equation. Just because you did not refer to it in the text does not mean some future reader might not need to refer to it. It is cumbersome to have to use circumlocutions like "the equation second from the top of page 3 column 1". (Note that the ruler will not be present in the final copy, so is not an alternative to equation numbers). All authors will benefit from reading Mermin's description of how to write mathematics: http://www.pamitc.org/documents/mermin.pdf.

1.8. Miscellaneous

Compare the following:
$conf_a$ $conf_a$
conf_a conf_a
See The TeXbook, p165.

The space after e.g., meaning "for example", should not be a sentence-ending space. So e.g. is correct, e.g. is not. The provided \eg macro takes care of this.

When citing a multi-author paper, you may save space by using "et alia", shortened to "et al." (not "et. al." as "et" is a complete word). If you use the \etal macro provided, then you need not worry about double periods when used at the end of a sentence as in Alpher et al. However, use it only when there are three or more authors. Thus, the following is correct: "Frobnication has been trendy lately. It was introduced by Alpher [?], and subsequently developed by Alpher and Fotheringham-Smythe [?], and Alpher et al. [?]."

This is incorrect: "... subsequently developed by Alpher et al. [?] ..." because reference [?] has just two authors.

2. Formatting your paper

All text must be in a two-column format. The total allowable size of the text area is $6\frac{7}{8}$ inches (17.46 cm) wide by $8\frac{7}{8}$ inches (22.54 cm) high. Columns are to be $3\frac{1}{4}$ inches (8.25 cm) wide, with a $\frac{5}{16}$ inch (0.8 cm) space between them. The main title (on the first page) should begin 1 inch (2.54 cm) from the top edge of the page. The second and following pages should begin 1 inch (2.54 cm) from the top edge. On all pages, the bottom margin should be $1\frac{1}{8}$ inches (2.86 cm) from the bottom edge of the page for 8.5×11-inch paper; for A4 paper, approximately $1\frac{5}{8}$ inches (4.13 cm) from the bottom edge of the page.

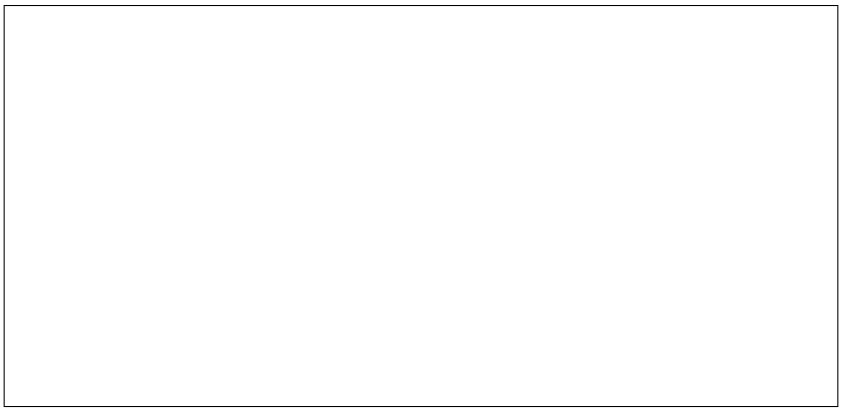
2.1. Margins and page numbering

All printed material, including text, illustrations, and charts, must be kept within a print area $6\frac{7}{8}$ inches (17.46 cm) wide by $8\frac{7}{8}$ inches (22.54 cm) high. Page numbers should be in the footer, centered and $\frac{3}{4}$ inches from the bottom of the page. The review version should have page numbers, yet the final version submitted as camera ready should not show any page numbers. The LaTeX template takes care of this when used properly.

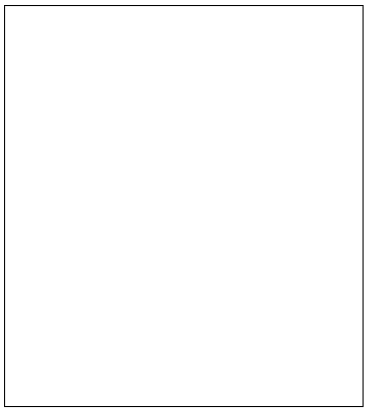
2.2. Type style and fonts

Wherever Times is specified, Times Roman may also be used. If neither is available on your word processor, please use the font closest in appearance to Times to which you have access.

MAIN TITLE. Center the title $1\frac{3}{8}$ inches (3.49 cm) from the top edge of the first page. The title should be in Times 14-point, boldface type. Capitalize the first letter of nouns, pronouns, verbs, adjectives, and adverbs; do not capitalize articles, coordinate conjunctions, or prepositions (unless the title begins with such a word). Leave two blank lines after the title.



(a) An example of a subfigure.



(b) Another example of a subfigure.

Figure 2. Example of a short caption, which should be centered.

AUTHOR NAME(s) and AFFILIATION(s) are to be centered beneath the title and printed in Times 12-point, non-boldface type. This information is to be followed by two blank lines.

The ABSTRACT and MAIN TEXT are to be in a two-column format.

MAIN TEXT. Type main text in 10-point Times, single-spaced. Do NOT use double-spacing. All paragraphs should be indented 1 pica (approx. $\frac{1}{6}$ inch or 0.422 cm). Make sure your text is fully justified—that is, flush left and flush right. Please do not place any additional blank lines between paragraphs.

Figure and table captions should be 9-point Roman type as in ?? and Fig. 2. Short captions should be centred.

Callouts should be 9-point Helvetica, non-boldface type. Initially capitalize only the first word of section titles and first-, second-, and third-order headings.

FIRST-ORDER HEADINGS. (For example, 1. Introduction) should be Times 12-point boldface, initially capitalized, flush left, with one blank line before, and one blank line after.

SECOND-ORDER HEADINGS. (For example, 1.1. Database elements) should be Times 11-point boldface, initially capitalized, flush left, with one blank line before, and one after. If you require a third-order heading (we discourage it), use 10-point Times, boldface, initially capitalized, flush left, preceded by one blank line, followed by a period and your text on the same line.

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Please use footnotes[1] sparingly. Indeed, try to avoid footnotes altogether and include necessary peripheral observations in the text (within parentheses, if you prefer, as in this sentence). If you wish to use a footnote, place it at the bottom of the column on the page on which it is referenced. Use Times 8-point type, single-spaced.

[1]This is what a footnote looks like. It often distracts the reader from the main flow of the argument.

2.4. Cross-references

For the benefit of author(s) and readers, please use the

```
\cref{...}
```

command for cross-referencing to figures, tables, equations, or sections. This will automatically insert the appropriate label alongside the cross-reference as in this example:

> To see how our method outperforms previous work, please see ?? and ??. It is also possible to refer to multiple targets as once, e.g. to ?? and Fig. 2a. You may also return to Sec. 2 or look at Eq. (2).

If you do not wish to abbreviate the label, for example at the beginning of the sentence, you can use the

```
\Cref{...}
```

command. Here is an example:

> ?? is also quite important.

2.5. Illustrations, graphs, and photographs

All graphics should be centered. In LaTeX, avoid using the center environment for this purpose, as this adds potentially unwanted whitespace. Instead use

```
\centering
```

at the beginning of your figure. Please ensure that any point you wish to make is resolvable in a printed copy of the paper. Resize fonts in figures to match the font in the body text, and choose line widths that render effectively in print. Readers (and reviewers), even of an electronic copy, may choose to print your paper in order to read it. You cannot insist that they do otherwise, and therefore must not assume that they can zoom in to see tiny details on a graphic.

When placing figures in LaTeX, it's almost always best to use \includegraphics, and to specify the figure width as a multiple of the line width as in the example below

```
\usepackage{graphicx} ...
\includegraphics[width=0.8\linewidth]
                {myfile.pdf}
```

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Please refer to the author guidelines on the CVPR 2023 web page for a discussion of the use of color in your document.

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References

[1] Kaiming He, Xiangyu Zhang, Shaoqing Ren, and Jian Sun. Deep residual learning for image recognition. In Proceedings of the IEEE conference on computer vision and pattern recognition, pages 770–778, 2016. 1