Deep Learning

KEEP CALM AND LOWER YOUR LEARNING RATE

Yannis Assael
Machine learning?

- Machine learning evolved from the study of AI
- Models learn and make predictions from data
- Deep Learning - Neural Networks

Deep Learning is awesome.....
2. Deep Learning

Neural Networks

INPUT: Image broken into pixels

Layer 1: Pixel values detected
L2: Edges identified
L3: Combinations of edges identified
L4: Features identified
L5: Combinations of features identified

OUTPUT: “Dog”
Human-level Control in Atari Videogames

[Mnih et al. 2015]
3. DL Research

AlphaGo Zero: Learning from scratch

- 3 days AlphaGo - Lee Sedol
- 21 Days AlphaGo - Ke Jie
- 40 days best go player in the world

<table>
<thead>
<tr>
<th>Game</th>
<th>Complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tic-tac-toe</td>
<td>$10^3$</td>
</tr>
<tr>
<td>Connect Four</td>
<td>$10^{13}$</td>
</tr>
<tr>
<td>Backgammon</td>
<td>$10^{20}$</td>
</tr>
<tr>
<td>Atoms in human body</td>
<td>$(10^{27})$</td>
</tr>
<tr>
<td>Reversi</td>
<td>$10^{28}$</td>
</tr>
<tr>
<td>Chess</td>
<td>$10^{47}$</td>
</tr>
<tr>
<td>Atoms in the universe</td>
<td>$(10^{82})$</td>
</tr>
<tr>
<td>Go (19x19)</td>
<td>$10^{170}$</td>
</tr>
</tbody>
</table>

[Silver et al. 2017]
Solve Riddles

<table>
<thead>
<tr>
<th>Action</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Day 3</th>
<th>Day 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>On</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Switch</td>
<td>On/Off</td>
<td>On/Off</td>
<td>On/Off</td>
<td>On/Off</td>
</tr>
</tbody>
</table>

[1] On

Day 2 Has Been?
- Yes: Off
- No: On

Day 3 Has Been?
- Yes: None
- No: Switch?
  - Yes: Tell
  - No: On

In JN Foerster, YM Assael, N de Freitas, S Whiteson, NIPS, 2016]
Good afternoon.

The United States will step up to the cost of a new challenges of the American people that will share the fact that we created the problem. They were attacked and so that they have to say that all the task of the final days of war that I will not be able to get this done. The promise of the men and women who were still going to take out the fact that the American people have fought to make sure that they have to be able to protect our part. It was a chance to stand together to completely look for the commitment to borrow from the American people. And the fact is the men and women in uniform and the millions of our country with the law system that we should be a strong stretcks of the forces that we can afford to increase our spirit of the American people and the leadership of our country who are on the Internet of America.

Thank you very much.

God bless you, and God bless the United States of America.

[Hochreiter et al. 1997; Karpathy 2015]
Can they write code?

/*
 * Increment the size file of the new incorrect UI_FILTER group information
 * of the size generatively.
 */

static int indicate_policy(void)
{
    int error;
    if (fd == MARN_EPT) {
        /*
         * The kernel blank will coel it to userspace.
         */
        if (ss->segment < mem_total)
            unblock_graph_and_set_blocked();
        else
            ret = 1;
            goto bail;
    }
    segaddr = in_SB(in.addr);
    selector = seg / 16;
    setup Works = true;
    for (i = 0; i < blocks; i++) {
        seq = bu[i++];
        bpf = bd->bd.next + i * search;
        if (fd) {
            current = blocked;
        }
    }
    rw->name = "Getjbbregs";
    bprm_self_clear(&iv->version);
    regs->new = blocks[(BPF_STATS << info->historidac)] | PFMR_CLOBATHINC_SECONDS << 12;
    return segtable;
}
How about music?

<table>
<thead>
<tr>
<th>Rank</th>
<th>Song Title</th>
<th>Epochs</th>
<th>Views</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Born Of Shells (5 epochs)</td>
<td></td>
<td>827</td>
</tr>
<tr>
<td>2</td>
<td>Renegades Of Furk (10 epochs)</td>
<td></td>
<td>437</td>
</tr>
<tr>
<td>3</td>
<td>Kill The Sire (15 epochs)</td>
<td></td>
<td>296</td>
</tr>
<tr>
<td>4</td>
<td>Like Ashes In The Fall Ha Ha (21 epochs)</td>
<td></td>
<td>1,083</td>
</tr>
<tr>
<td>5</td>
<td>A Street Fighting Man (26 epochs)</td>
<td></td>
<td>350</td>
</tr>
<tr>
<td>6</td>
<td>The Reviler (31 epochs)</td>
<td></td>
<td>405</td>
</tr>
<tr>
<td>7</td>
<td>Still And The Rose (37 epochs)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[soundcloud.com/graphific]
Unsupervised Machine Translation

English

Shared encoder (L1/L2)

fixed cross-lingual embeddings

French /

German

L1 decoder

softmax

attention

L2 decoder

softmax

attention

[Artetxe et al. 2017]

YES, YOU CAN TRANSLATE FROM ENGLISH TO GERMAN

BY READING ENGLISH AND GERMAN SEPERATELY!
Reasoning with Memory Networks!

Input text
Bilbo travelled to the cave.  
Gollum dropped the ring there.  
Bilbo took the ring.  
Bilbo went back to the Shire.  
Bilbo left the ring there.  
Frodo got the ring.  
Frodo journeyed to Mount-Doom.  
Frodo dropped the ring there.  
Sauron died.  
Frodo went back to the Shire.  
Bilbo travelled to the Grey-havens.  
The End.

Questions
Where is the ring? A: Mount-Doom  
Where is Bilbo now? A: Grey-havens  
Where is Frodo now? A: Shire

[Weston et al. 2014]
3. DL Research

LipNet

Sentence: Place blue in m 1 soon
LipNet:

[Y. Assael, B. Shillingford], S. Whiteson, N. de Freitas, 2016
Image-to-Image Generation

[Isola et al. 2016]
Neural Artistic Styles

[Oxford]

[van Gogh]

[Turner]

[Munch]

[Gatys et al. 2015]
KEEP CALM AND APPLY TO OXFORD