

CS5600/6600: F24: Project 1 Notes

Computing with Honey Bees

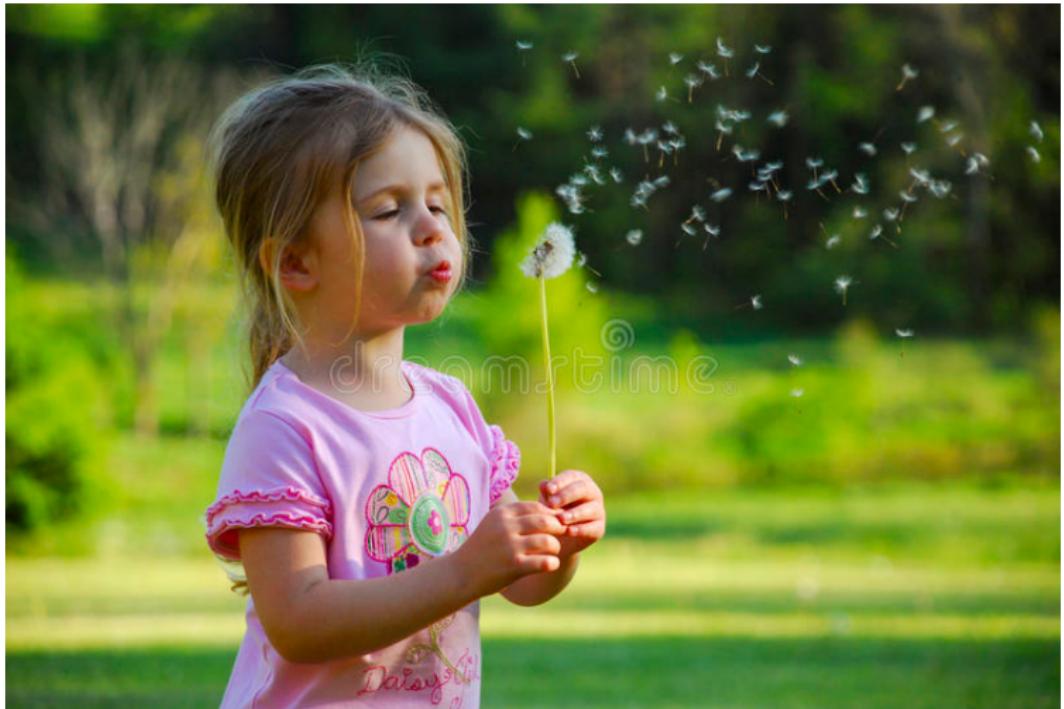
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A World without Bees?



TIME, August 19, 2013

Homework Assignment



What's a Hive?



Dr. Meikle's Research Hive, USDA-ARS Honey Bee Lab, Tucson, AZ

What's a Bee Hive Frame?



A Hive Frame, USDA-ARS Honey Bee Lab, Tucson, AZ

Question 1

What Types of Bees Live in a Hive?

Answer 1: Bee Type 1



1. Queen

Answer 1: Bee Type 2



2. Drones

Answer 1: Bee Type 3



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3. Worker Bees

My Research Lab



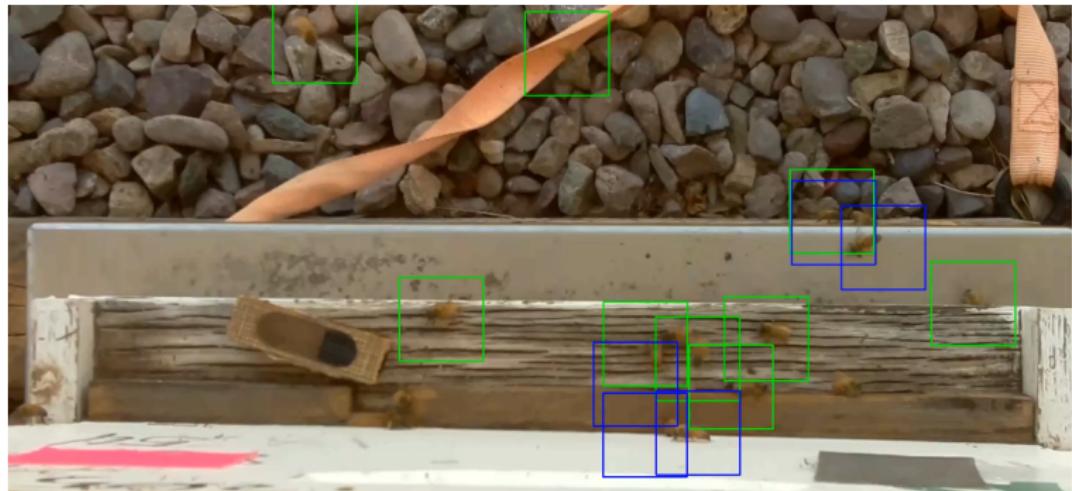
Two pictures from my research lab

Hey, Hive, Can We See Traffic?



We can place cameras in front of the hive. USU Botanical Center in Kaysville, UT. June 2024.

Hey, Hive, Can We Count Your Bees?



A video frame from a hive entrance traffic video in Tucson, AZ, July 2021

Hey, Hive, Can We See Your Frames?



A 2013 bee hive frame photo taken at USDA-ARS research apiary in Tucson, AZ.

Hey, Hive, Can We See Your Frames?



A 2013 bee hive frame photo taken at a USDA-ARS research apiary in Tucson, AZ.

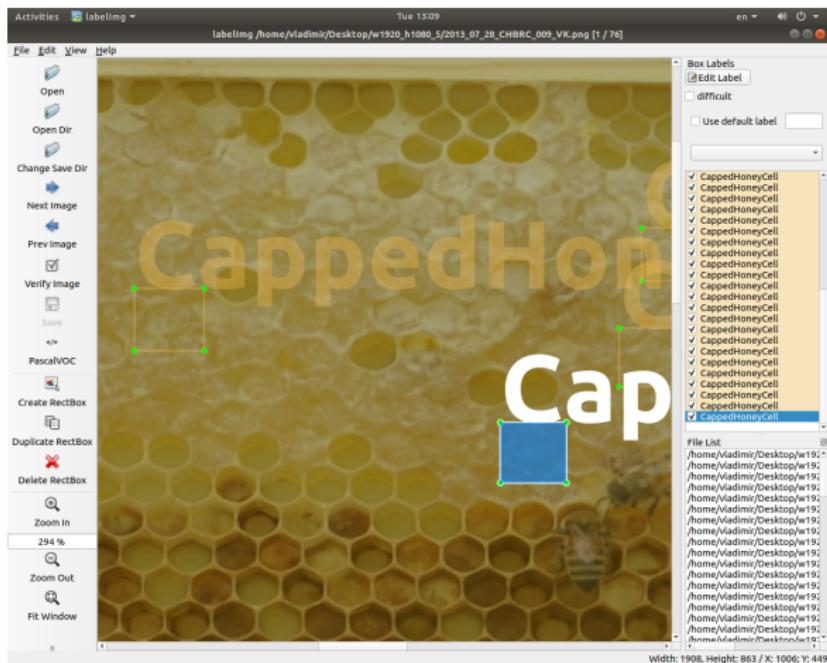
Hey, Hive, Can We Analyze Your Frames?

Let us propose the following categories to classify frame cells.

1. CappedHoneyCell;
2. CappedWorkerBroodCell;
3. EmptyCombCell;
4. PollenCell;
5. UncappedNectarCell;
6. UncappedWorkerLarvaCell;
7. BeeHiveFrame.

Hey, Hive, Can We Annotate Your Frames?

We can use an image annotation tool (e.g., LabelImg) to annotate digital images of bee frames.



An annotated CappedHoneyCell.

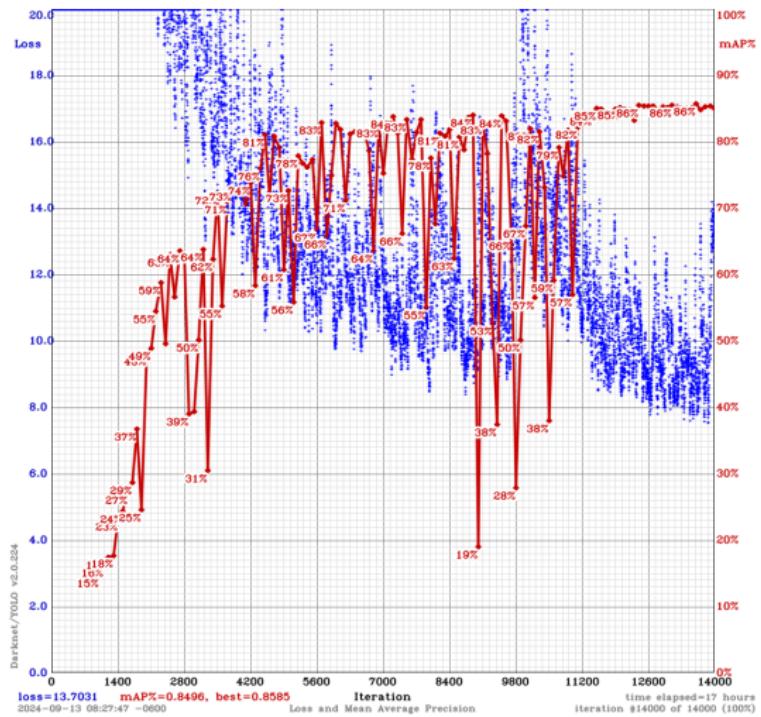
Hey, Hive, Can We Annotate Your Frames?

Annotation gives us images (PNG/JPG) and XML files.

```
<object>
  <name>BeeHiveFrame</name>
  <bndbox>
    <xmin>7</xmin>
    <ymin>104</ymin>
    <xmax>1915</xmax>
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  </bndbox>
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    <xmin>1725</xmin>
    <ymin>398</ymin>
    <xmax>1758</xmax>
    <ymax>432</ymax>
  </bndbox>
</object>
```

Hey, Hive, Can We Train DNNs To Analyze Your Frames?

We can train different DNN architectures on annotated datasets of bee hive frame images.



A YOLOv4 training performance chart on a set of annotated hive frames.



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Train YOLOv8n on a dataset of 50 annotated hive frame images.

Question: What profession has the most beautiful eyes?

Answer: Beekeepers, because beauty is
in the eye of the bee holder.

Thank You!



Acknowledgments

I express my profound gratitude to

1. All supporters of my three open science fundraisers on kickstarter.com for my electronic beehive monitoring research in 2017, 2019, and 2021 (type “Vladimir Kulyukin BeePi: Honeybees Meet AI kickstarter” on www.duckduckgo.com for more info).
2. Numerous private property owners in northern Utah for allowing me to use their property for my field experiments.
3. William Meikle and Milagra Weiss for giving me access to their research apiary at the USDA-ARS Honey Bee Lab in Tucson, AZ.
4. Andree Walker, Director of the USU Extension Thriving Beehives program, for giving me access to her teaching apiary at the USU Botanical Center in Kaysville, UT.