Pattern Recognition Lecture "Summary, Applications, and Conclusions"

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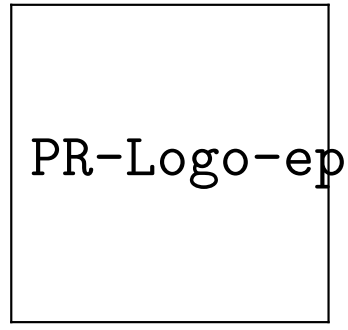


Topics

No	Topic
01	Introduction and Outline
02	Classifiers Based on Bayes Decision Theory
03	Linear Classifiers
04	Nonlinear Classifiers
05	Feature Selection
06	Feature Generation I
07	~~Feature Generation II~~
08	Template Matching
09	Context-Dependent Classification
10	~~Supervised Learning: The Epilogue~~
11	Clustering: Basics Concepts
12	Clustering Algorithms I: Sequential Algorithms
13	Clustering Algorithms II: Hierarchical Algorithms
14	Clustering Algorithms III: Schemes Based on Function Optimisation
15	Summary, Applications, and Conclusions

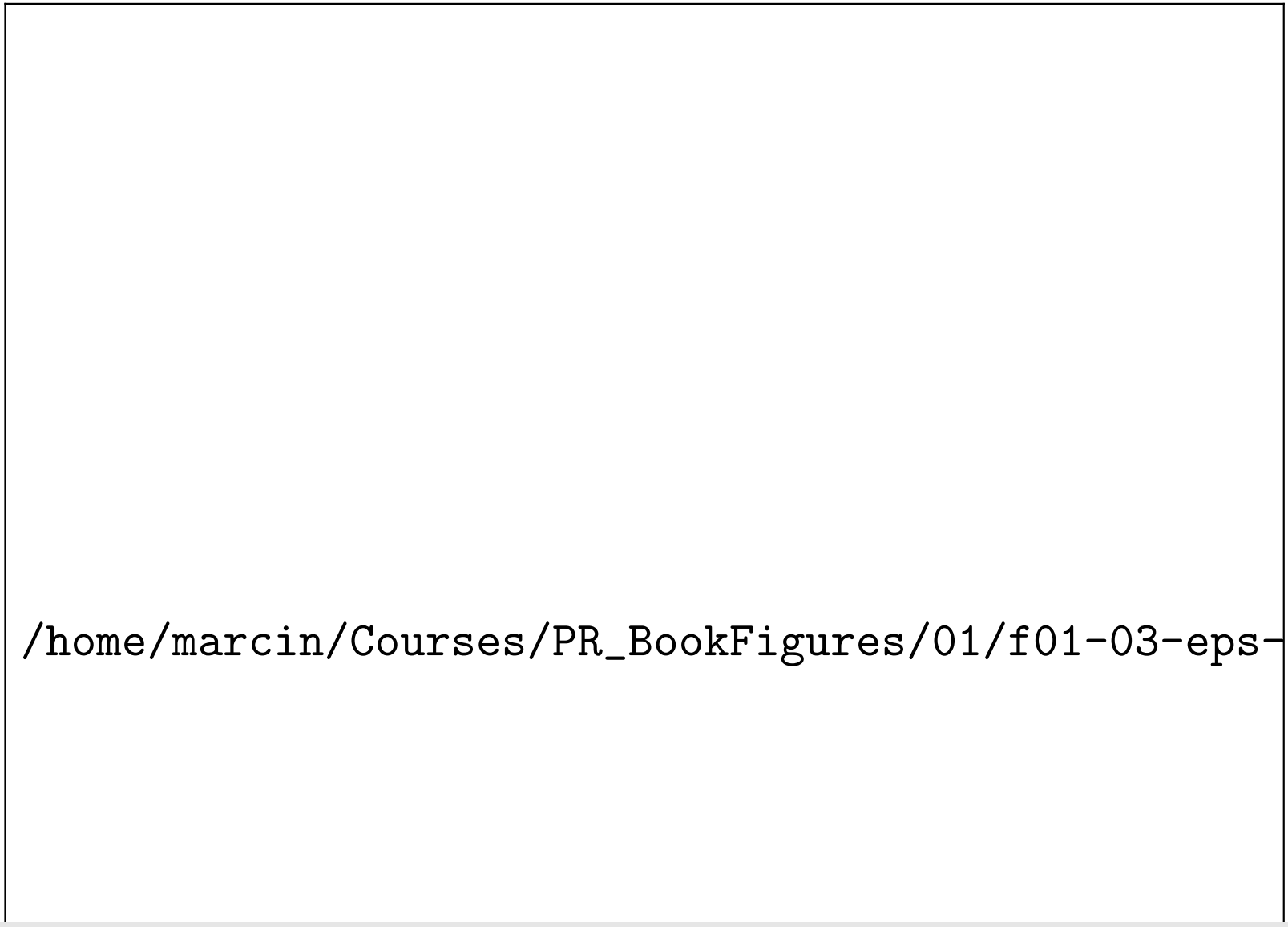
Adaptive Learning of Context

for Pattern Recognition

Overview

Overview

Basic Stages of Pattern Analysis



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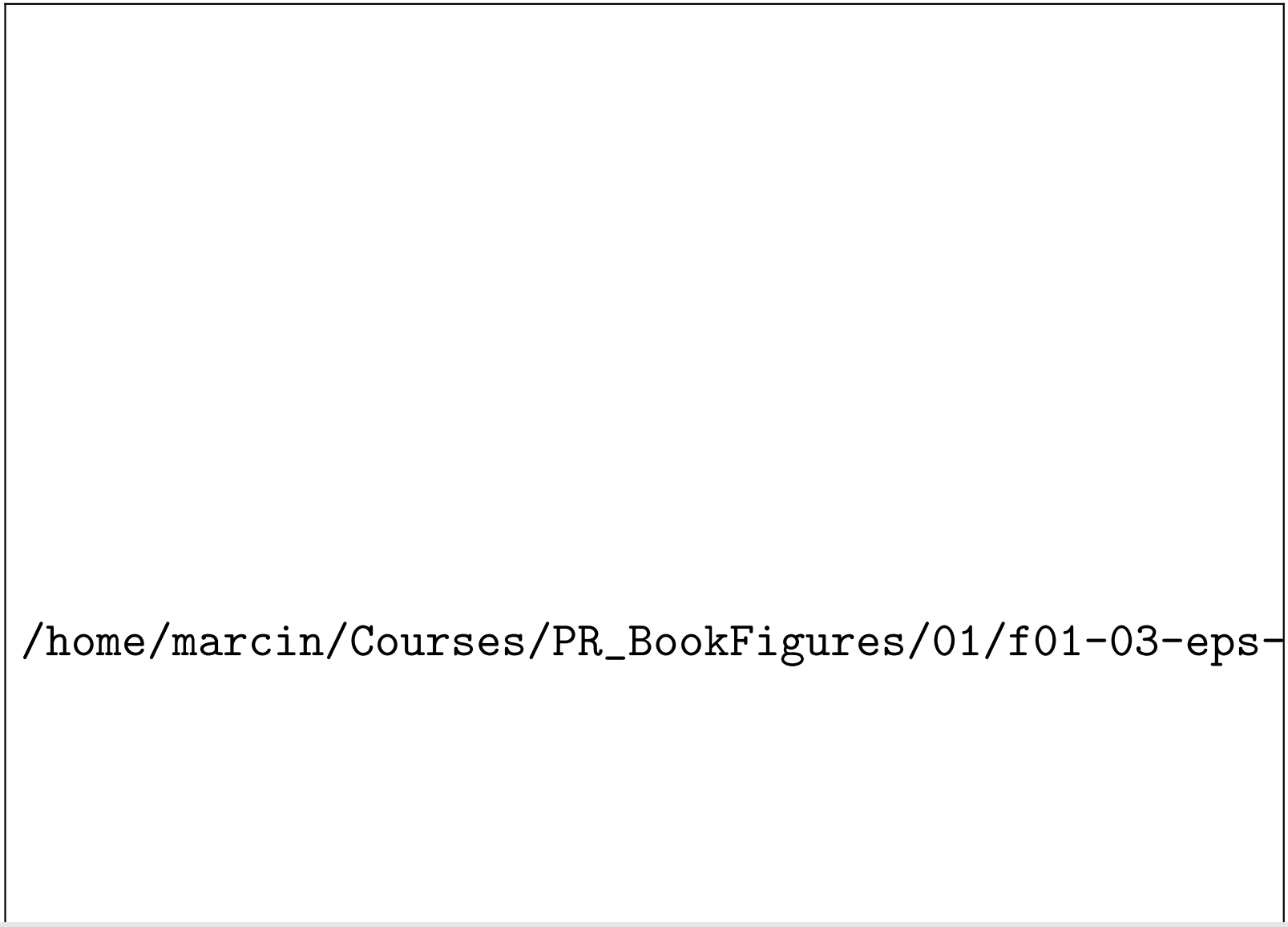

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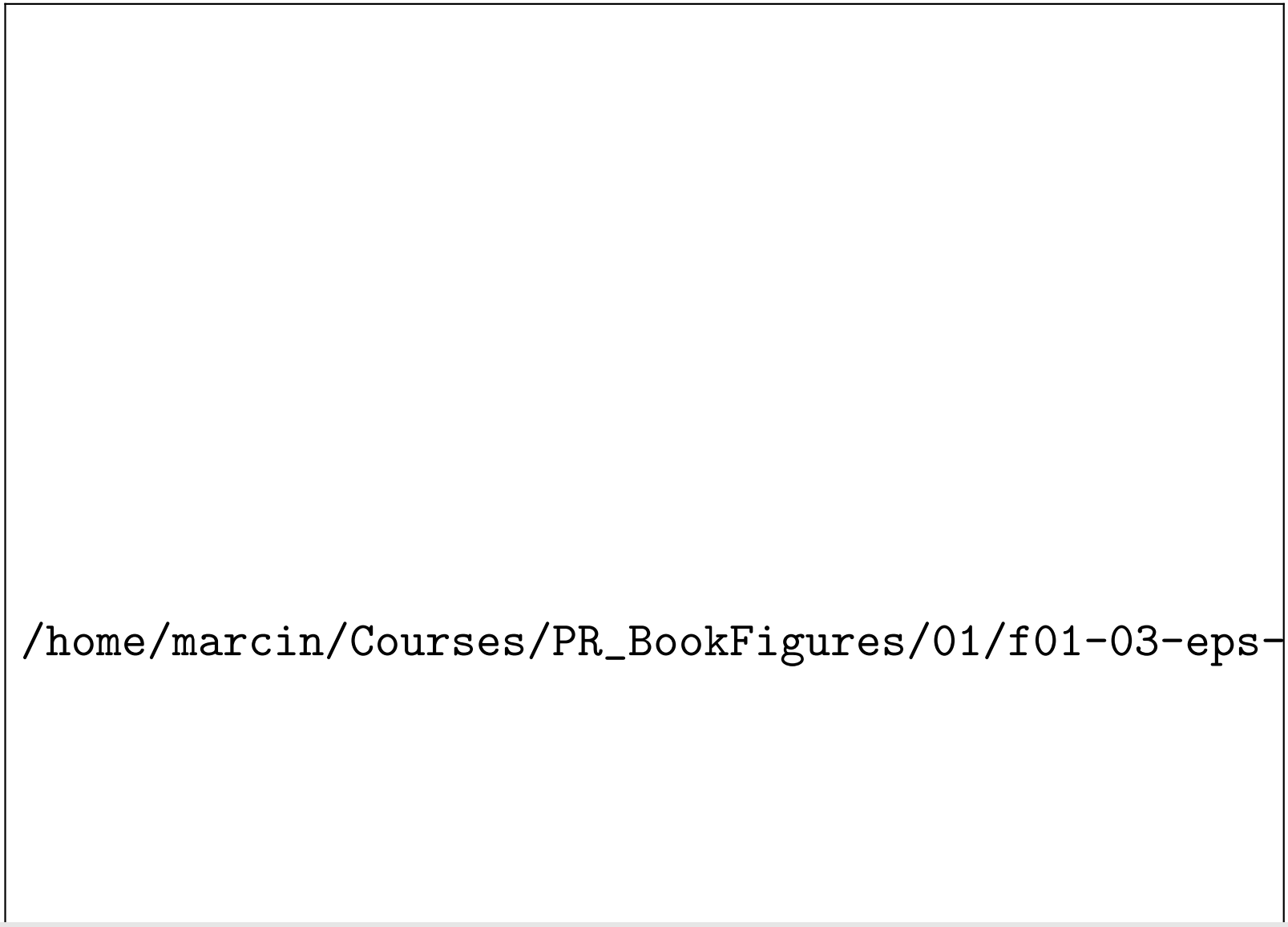

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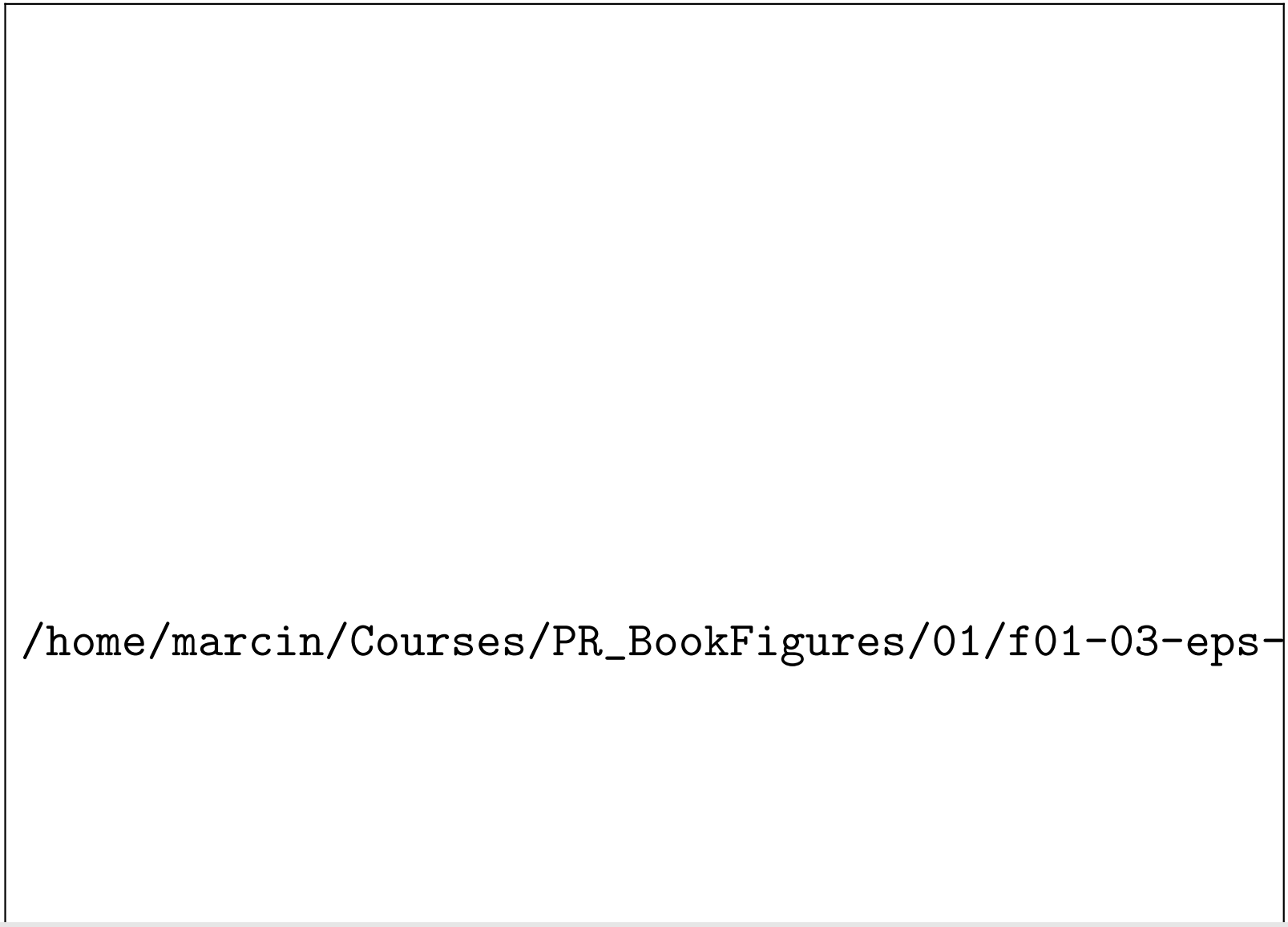


Scientific Methods for Pattern Recognition

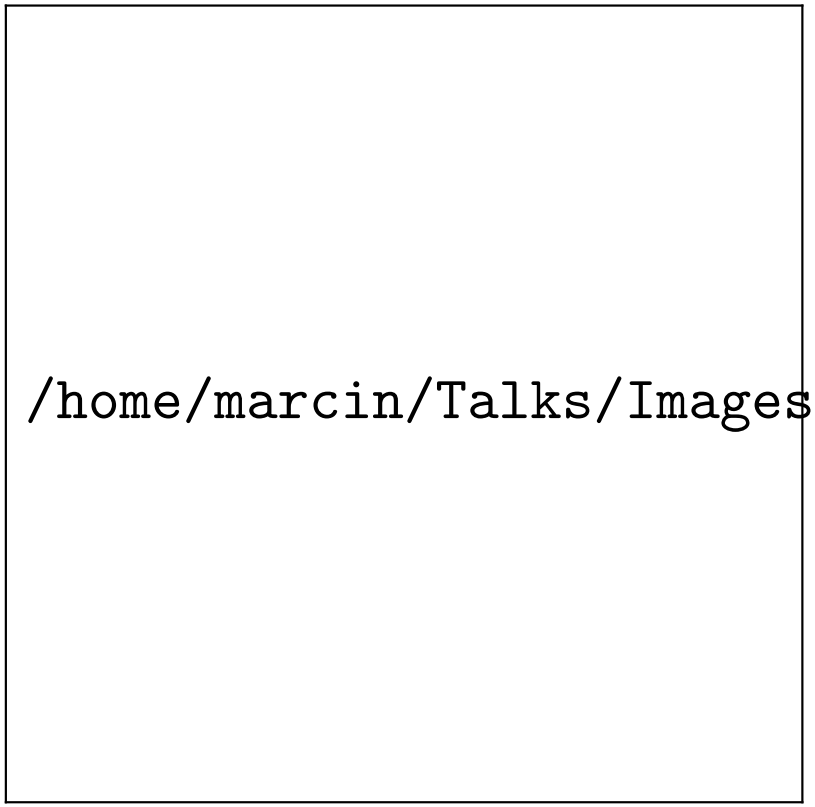
Example

- Generic Appearance-Based Statistical Object Recognition

Industrial Systems for Pattern Recognition

Example

- Automatic Sorting of Aluminium Alloys



Properties

- Concrete Application Domain
- Problem-Specific Features

Adaptive Learning for Pattern Recognition

Development Phase

- Generic System for Pattern Recognition
- Multiple Sensors, Features, and Classifiers

Adaptive Learning for Pattern Recognition

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- Generic System for Pattern Recognition
- Multiple Sensors, Features, and Classifiers

Supervision Phase

- Application for a Concrete Task
- Labelling of Misclassified Patterns by a Supervisor
- Adaptive Optimisation of the Processing Chain

Adaptive Learning for Pattern Recognition

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- Generic System for Pattern Recognition
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Supervision Phase

- Application for a Concrete Task
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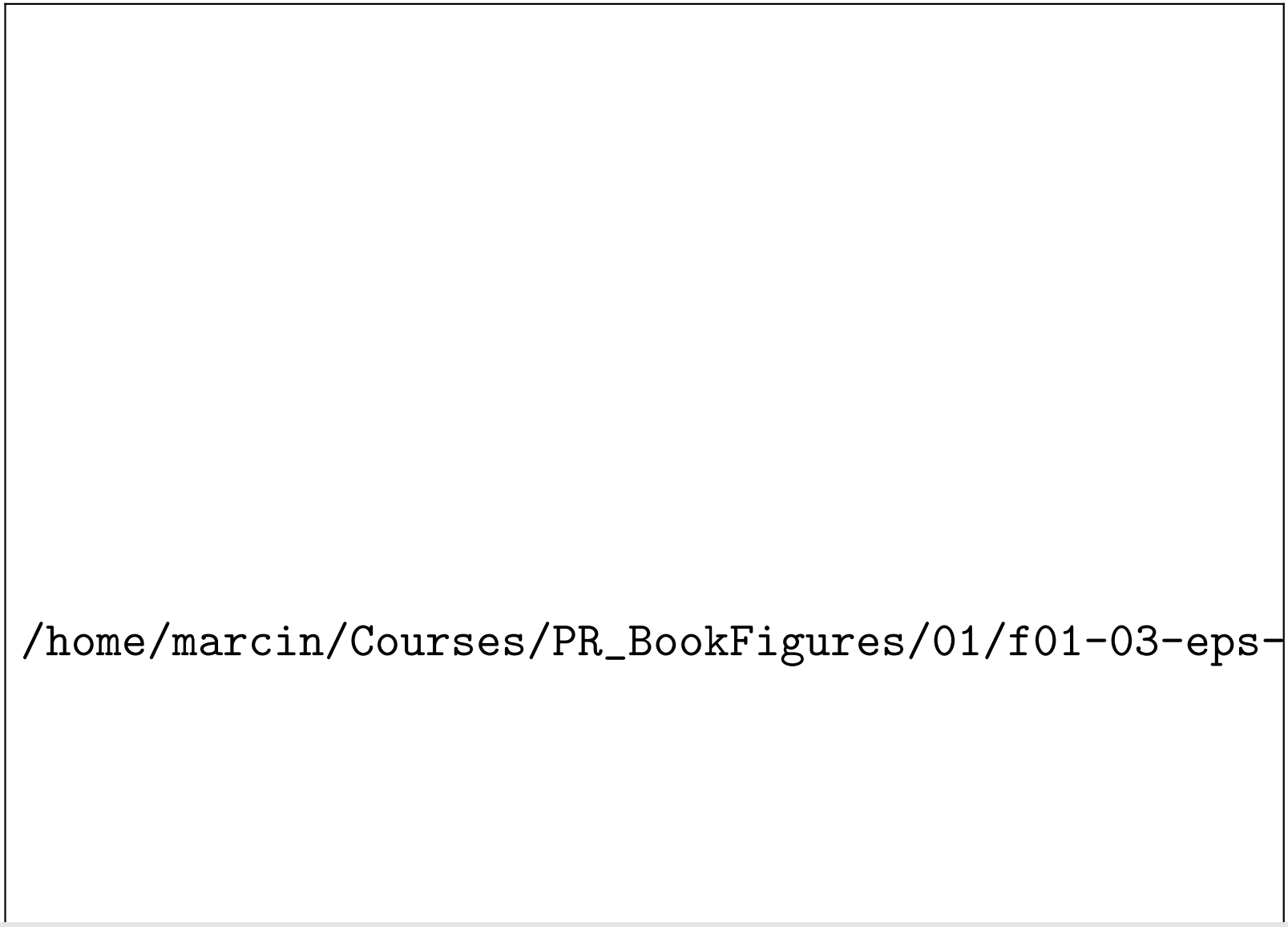
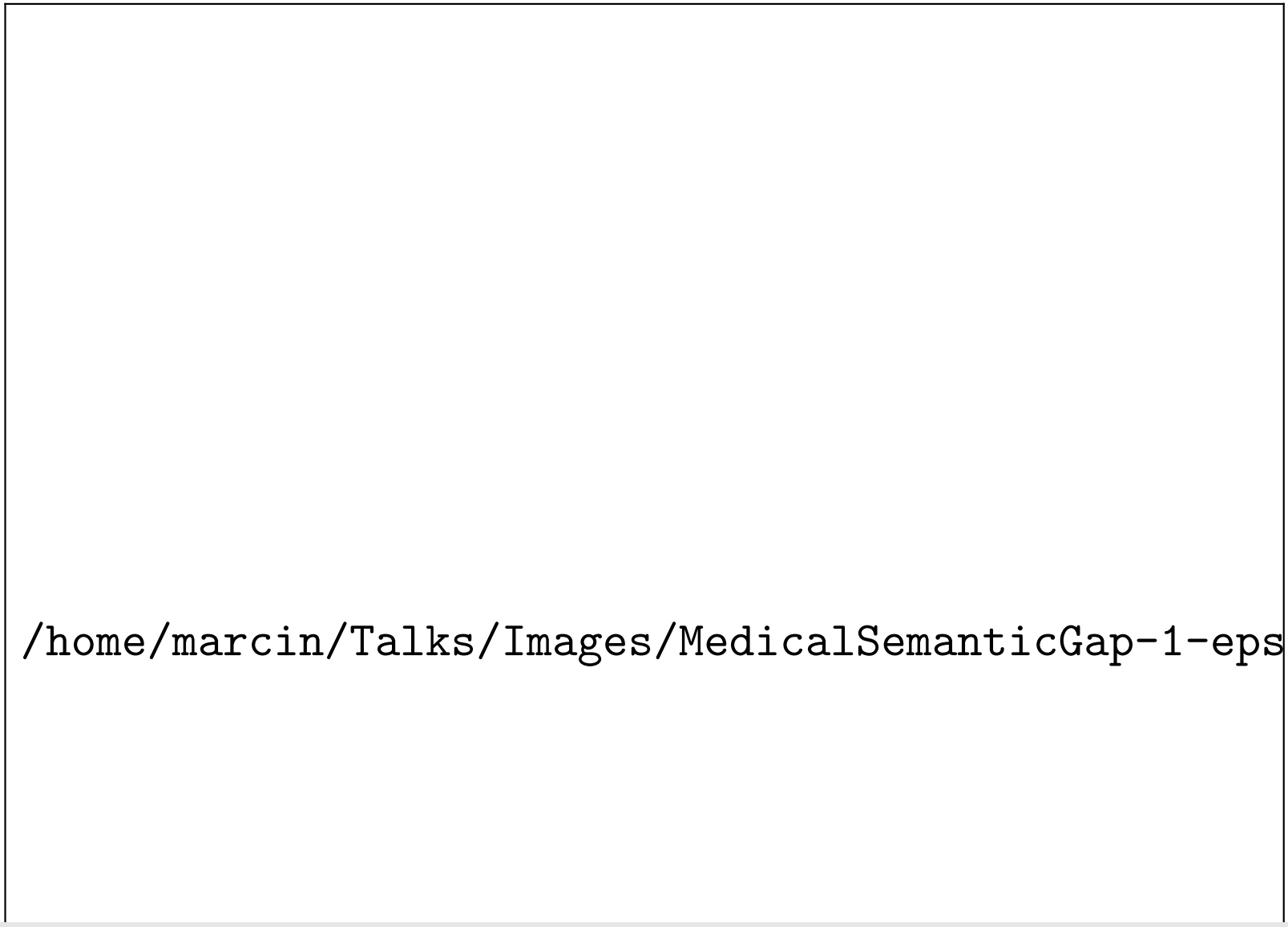
Recognition Phase

- Further Application without Supervision

Basic Stages of Pattern Analysis



Semantic Gap in Image Understanding



Overview

Research Areas

Multimodal Object Recognition and Scene Analysis

- Origin: University of Erlangen-Nuremberg
- Finalised: Appearance-Based Statistical Object Recognition
- Ongoing: Object Recognition in Multimodal Sensory Data
- Ongoing: Skeleton-Based Representation of Articulating Objects
- Ongoing: Matching of 3D Objects Based on 3D Curves
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- Origin: Queen Mary, University of London
- Finalised: Content-Based Video Retrieval
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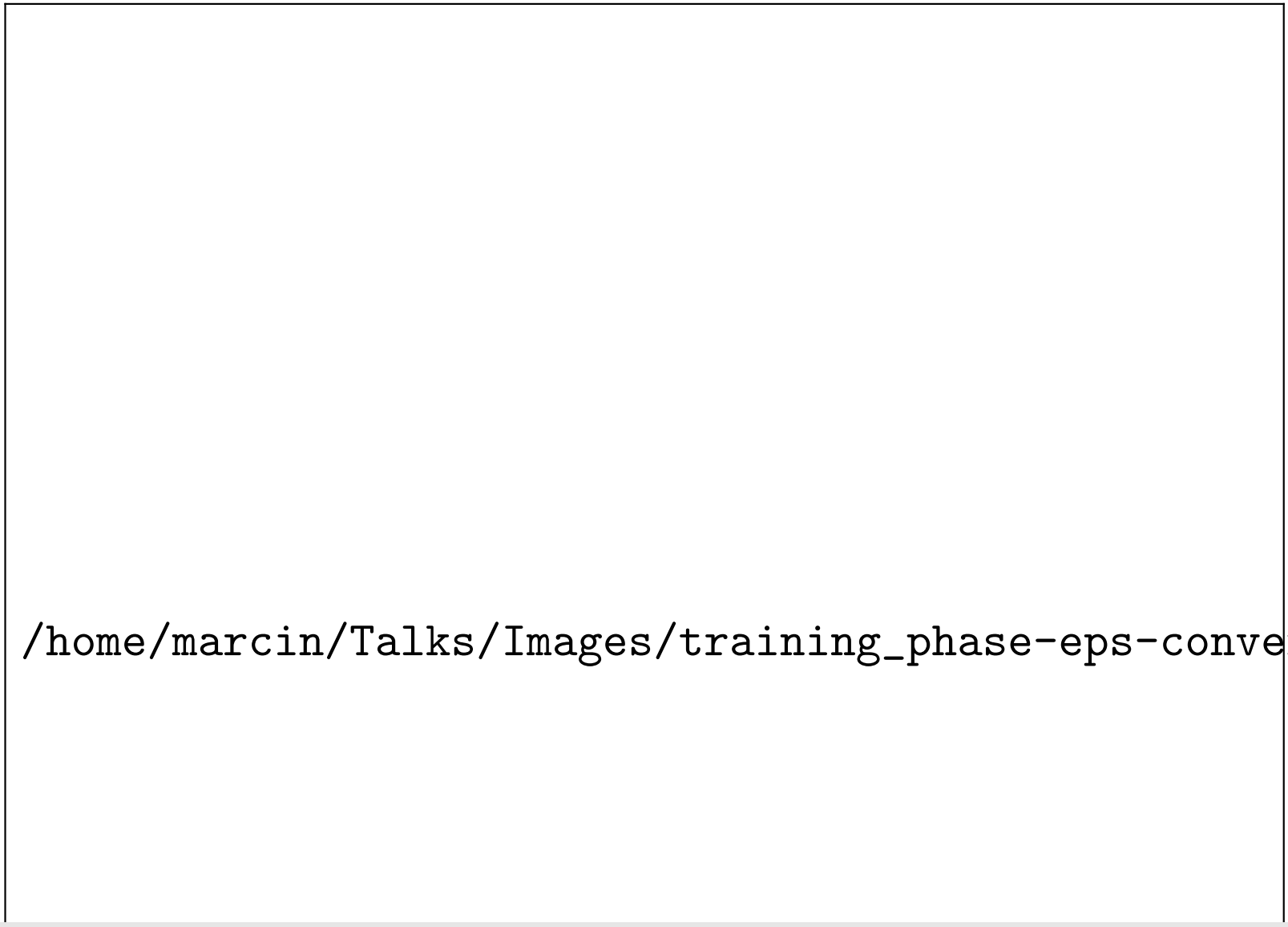
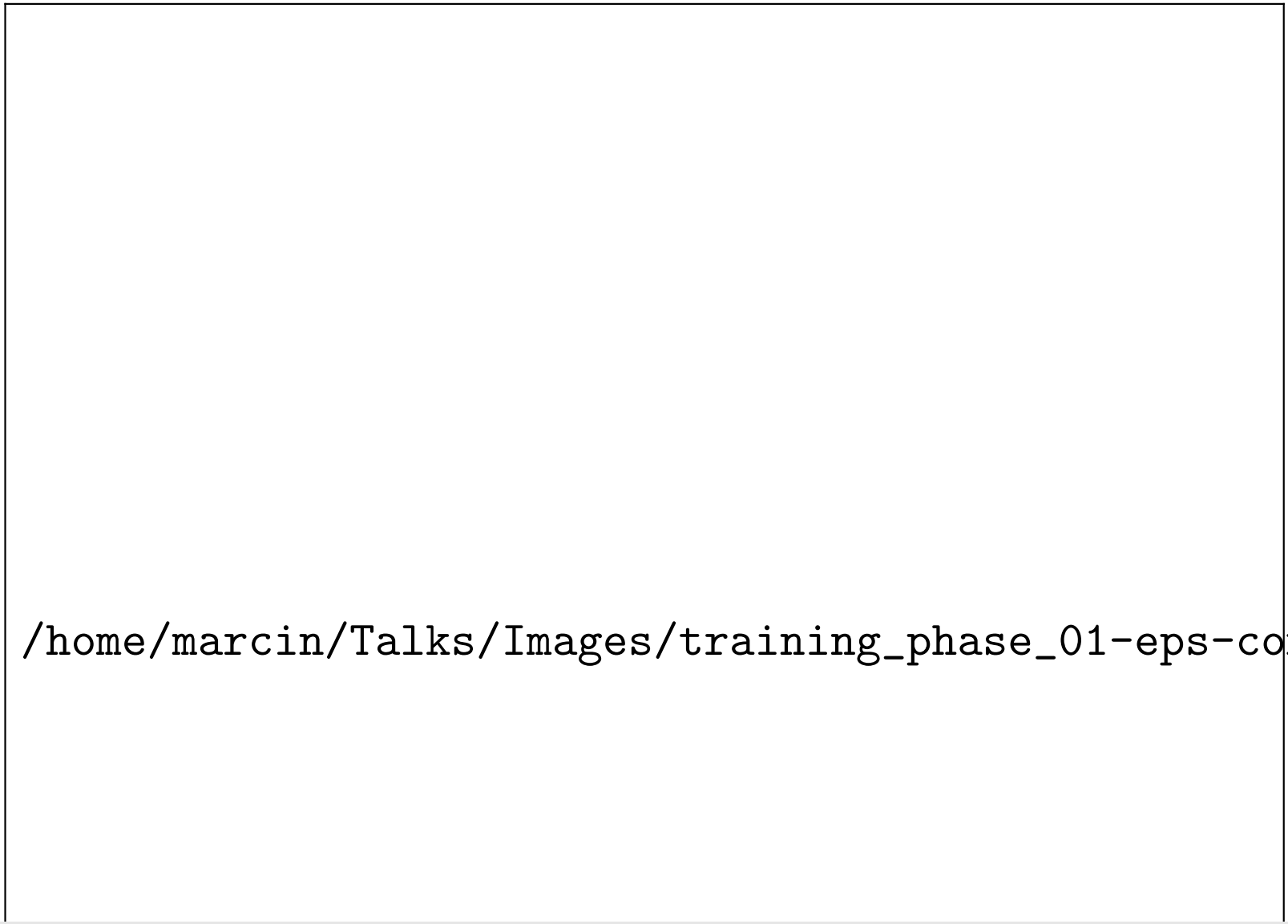
- Ongoing: Ontology-Based Medical Image Processing

Overview

Training Phase

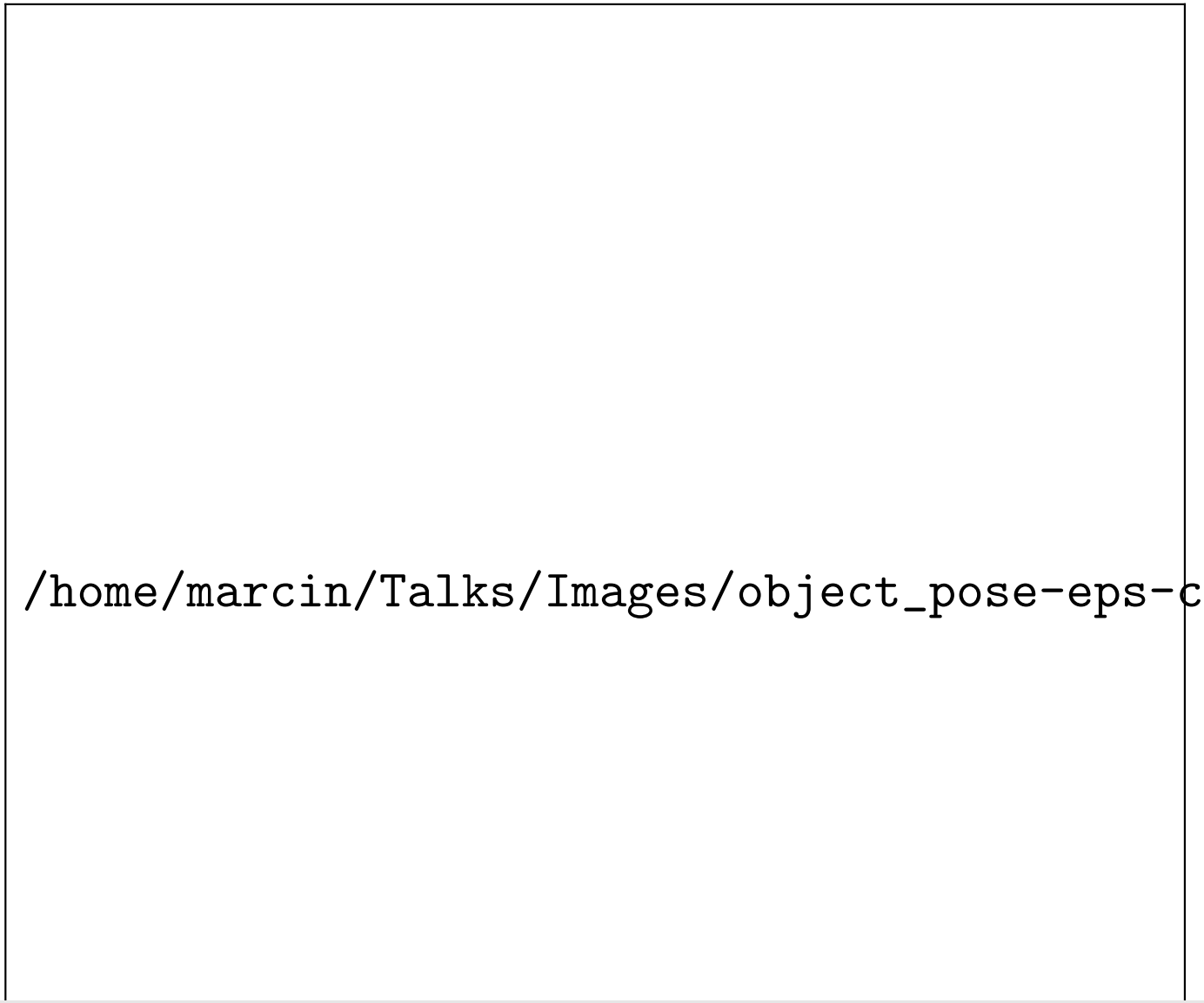


Turntable and Camera Arm



Turntable and Camera Arm

Object Pose



Hand-Held Camera

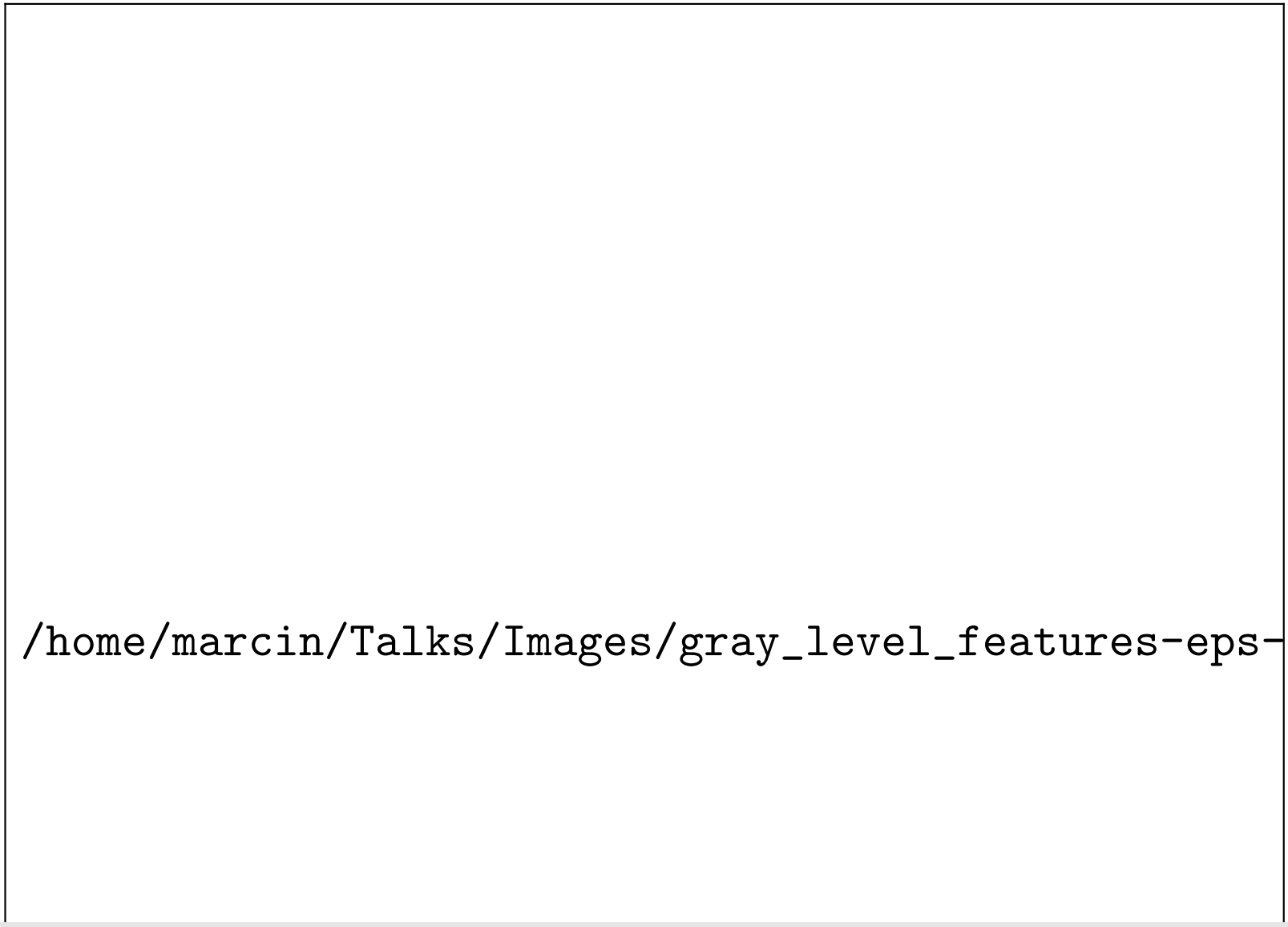
Hand-Held Camera

Pose Parameter Reconstruction

Grey Level Images

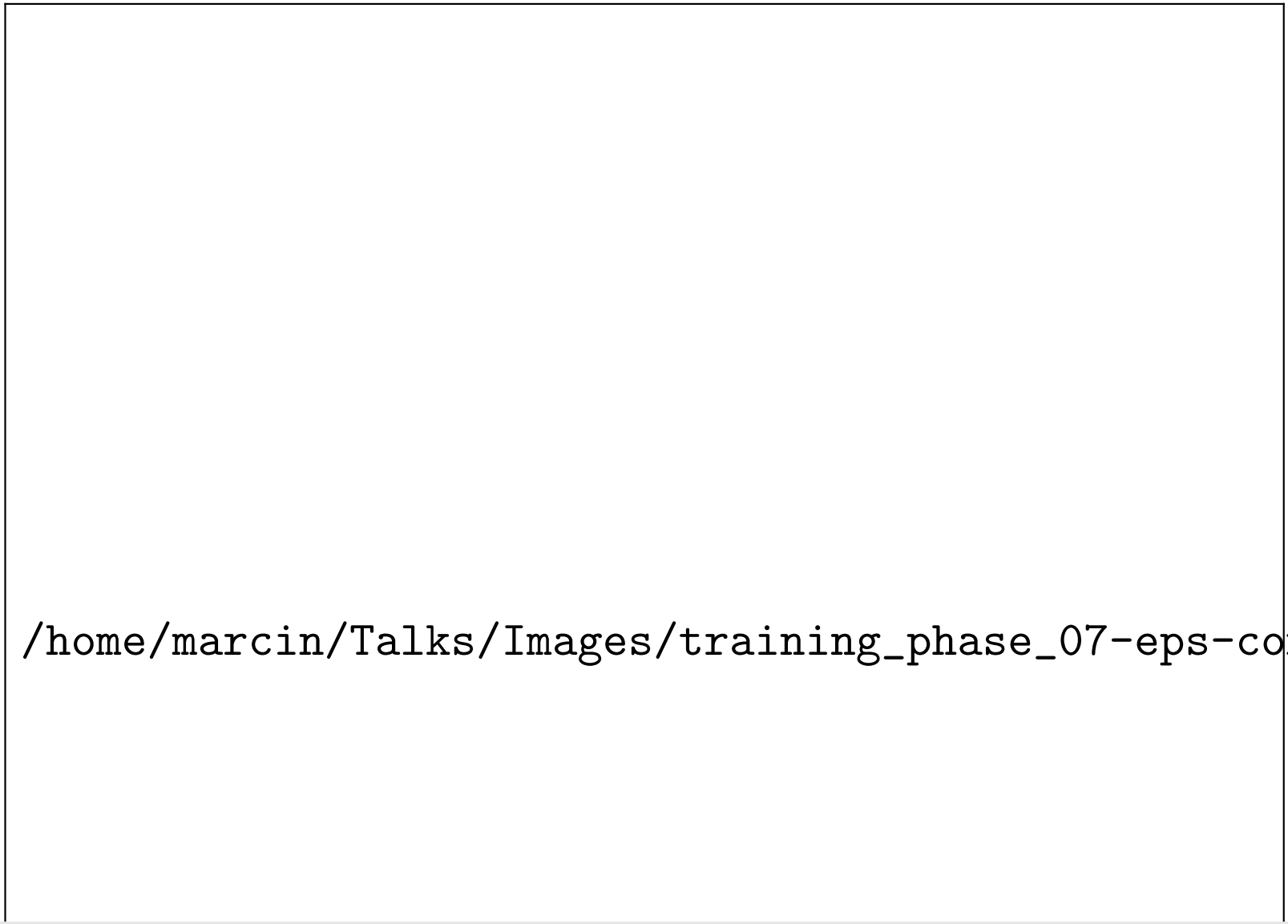
2D Local Feature Vectors

2D Feature Extraction with Wavelet Transform



Colour Images

6D Local Feature Vectors



Object Area

Object Area $O = O(\phi, \mathbf{t})$

Statistical Object Modelling

Statistical Background Modelling

Statistical Object Model

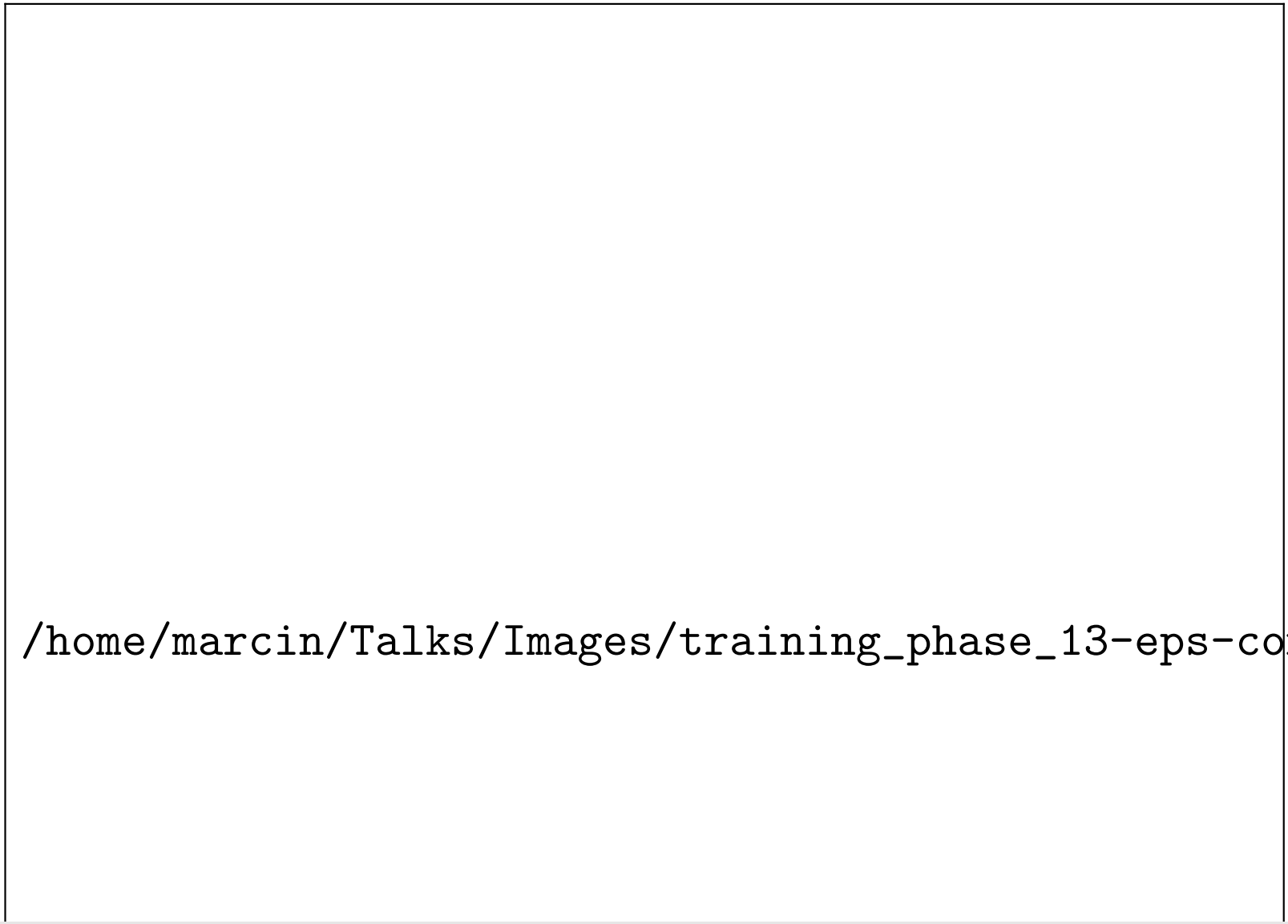
Statistical Object Model - Summary

$$\Omega_\kappa \quad \longrightarrow \quad \mathcal{M}_\kappa = \mathcal{M}_\kappa(\phi, \mathbf{t})$$

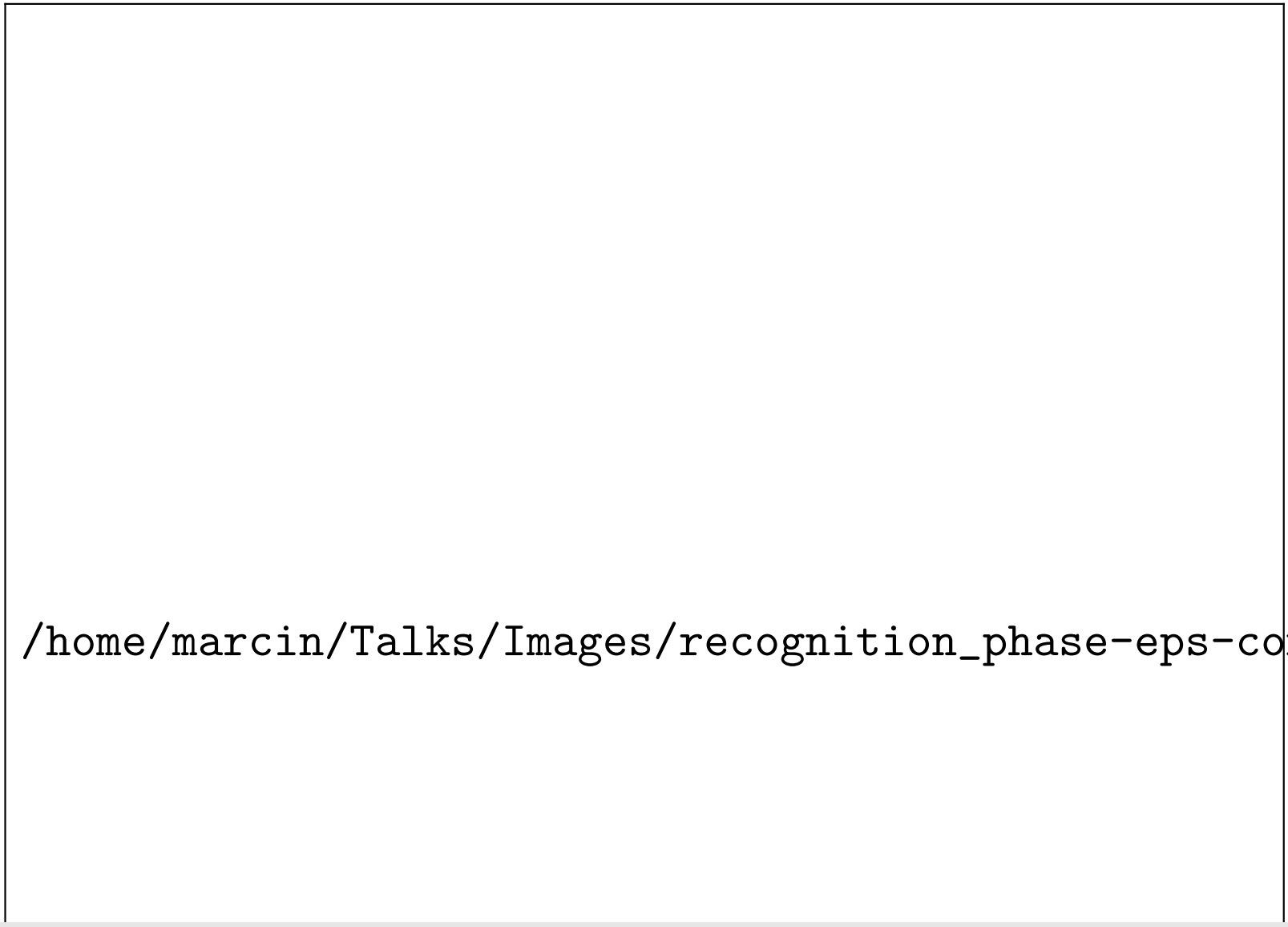
1. Object Area $O_\kappa = O_\kappa(\phi, \mathbf{t})$
2. Densities for Object Features $p(\mathbf{c}_m) = p(\mathbf{c}_m|\boldsymbol{\mu}_m, \boldsymbol{\sigma}_m, \phi, \mathbf{t})$
3. Densities for Background Features $p(\mathbf{c}_m) = p_b$

Context Modelling

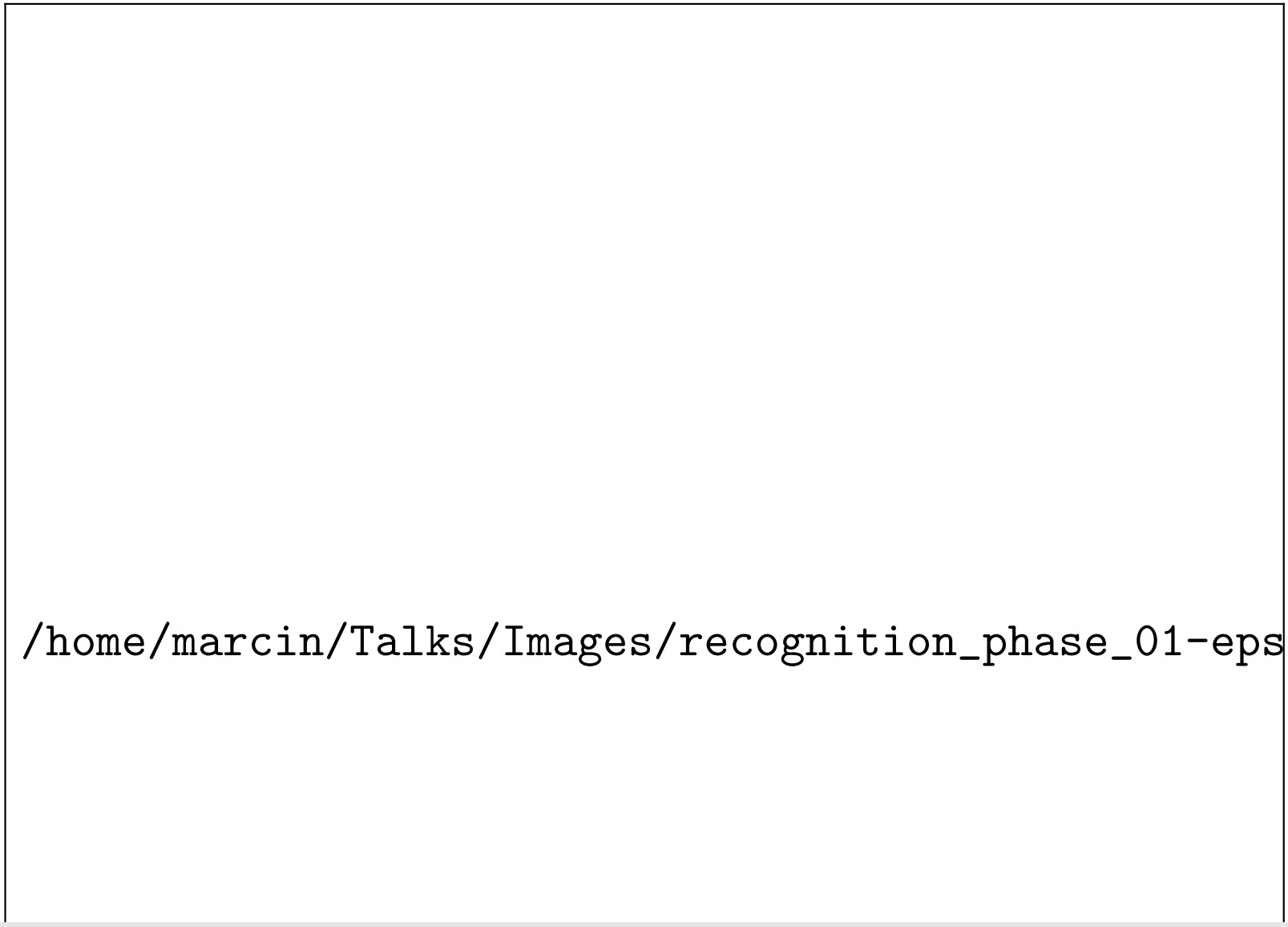
Training Phase Completed



Recognition Phase

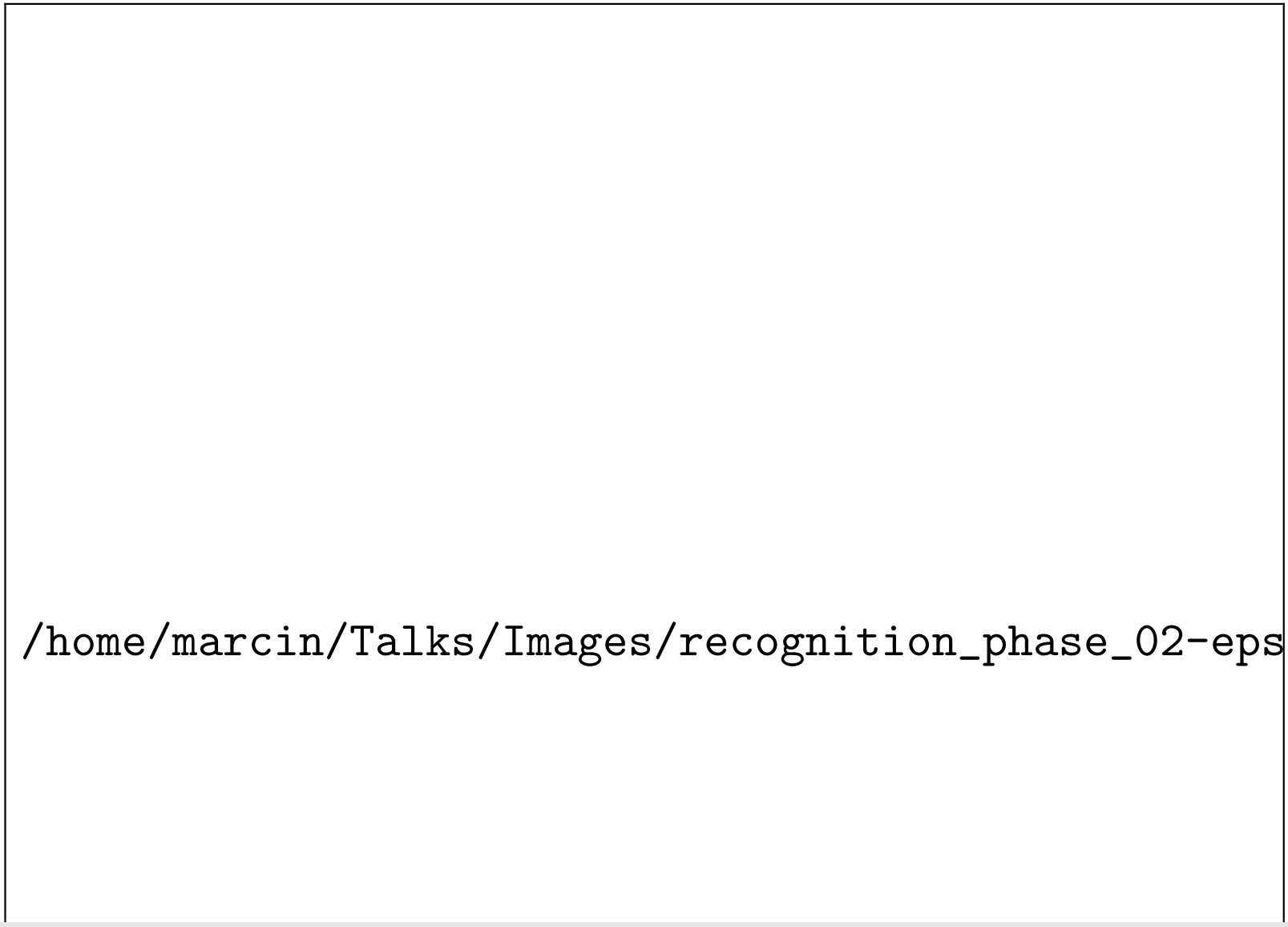


Single-Object, One Image

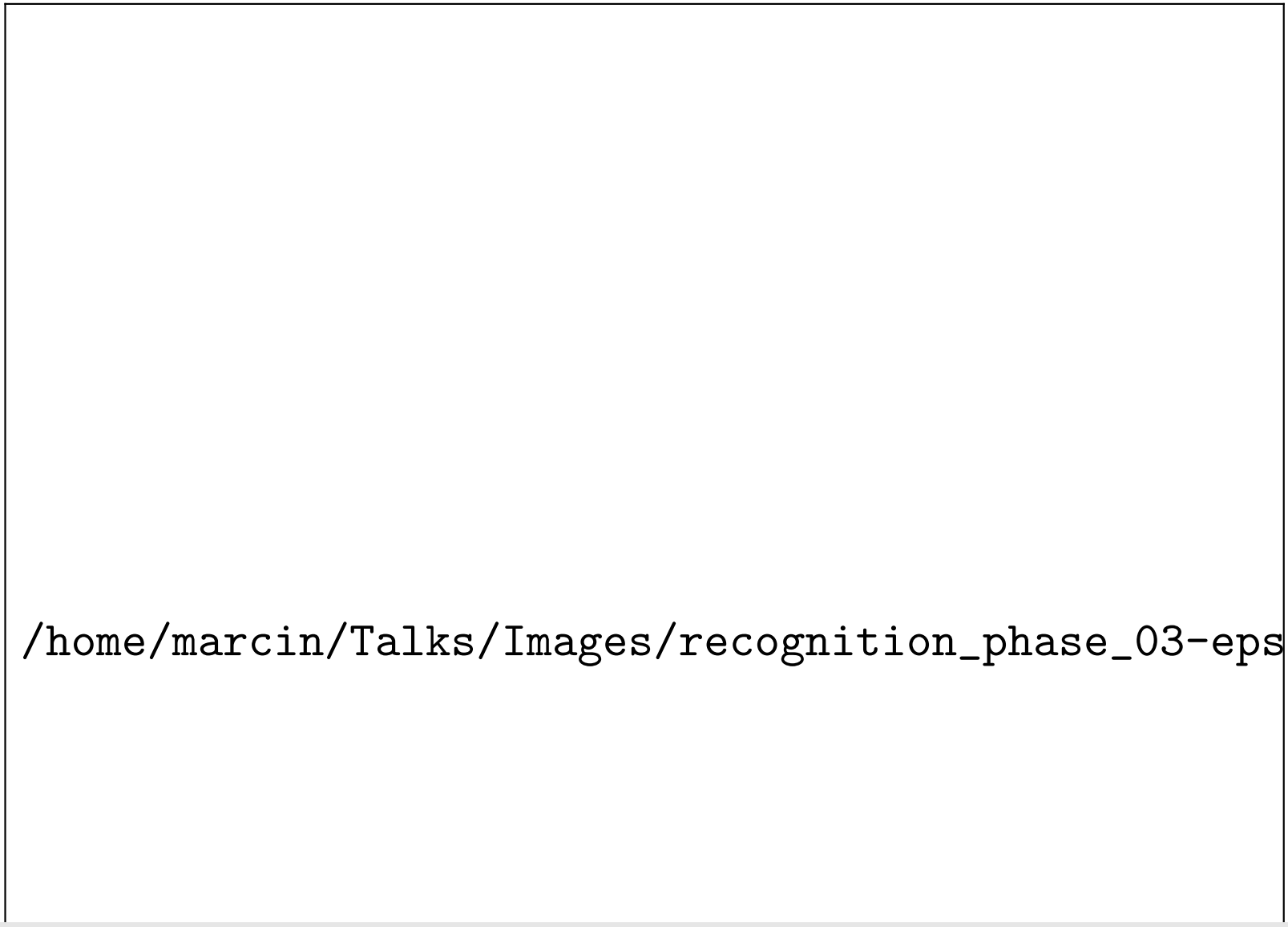


Classification and Localisation Algorithm

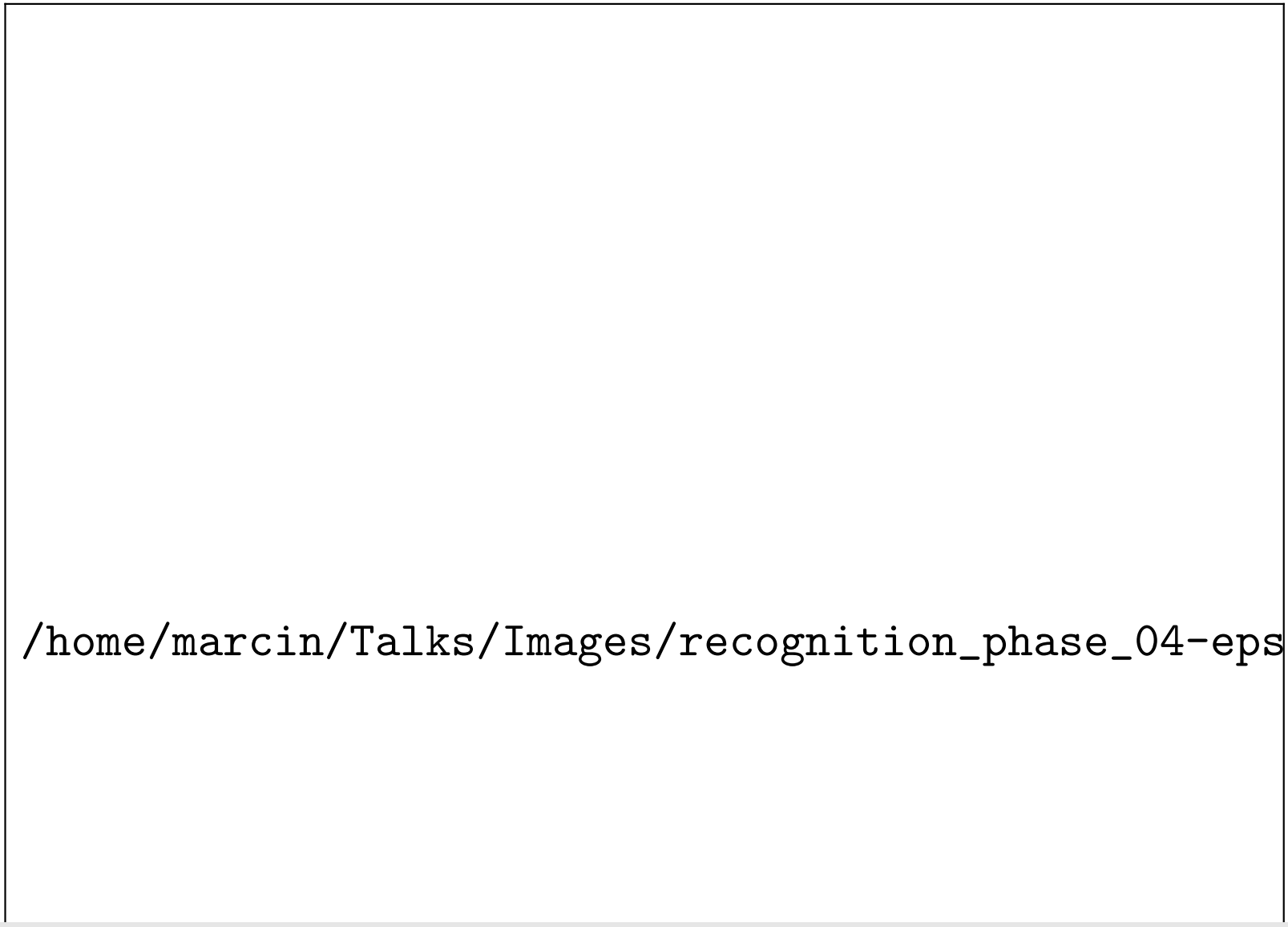
Single-Object, Multiple Views



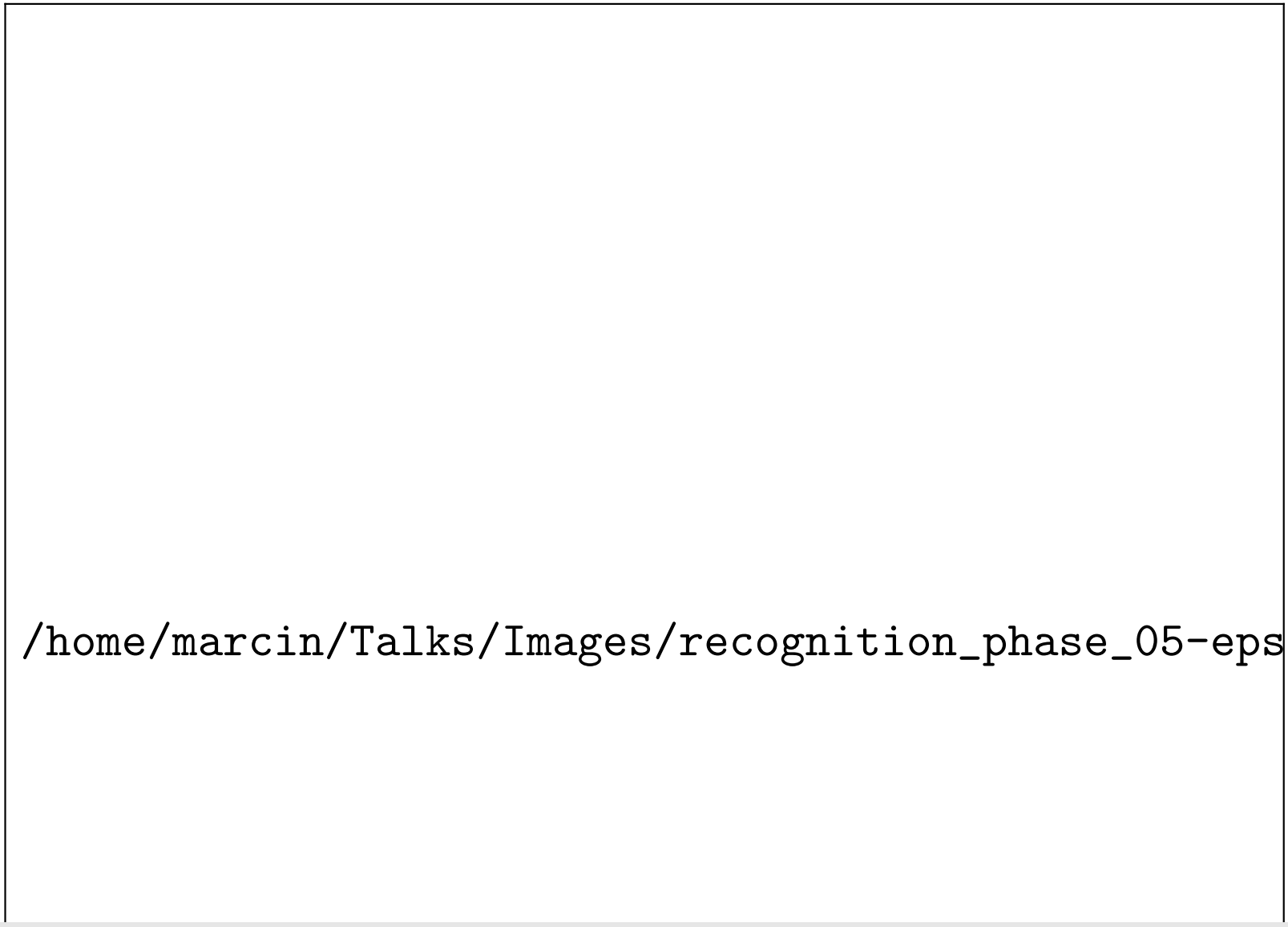
Multi-Object Scenes without Context



Multi-Object Scenes with Context



Recognition Phase Completed



Experiments and Results

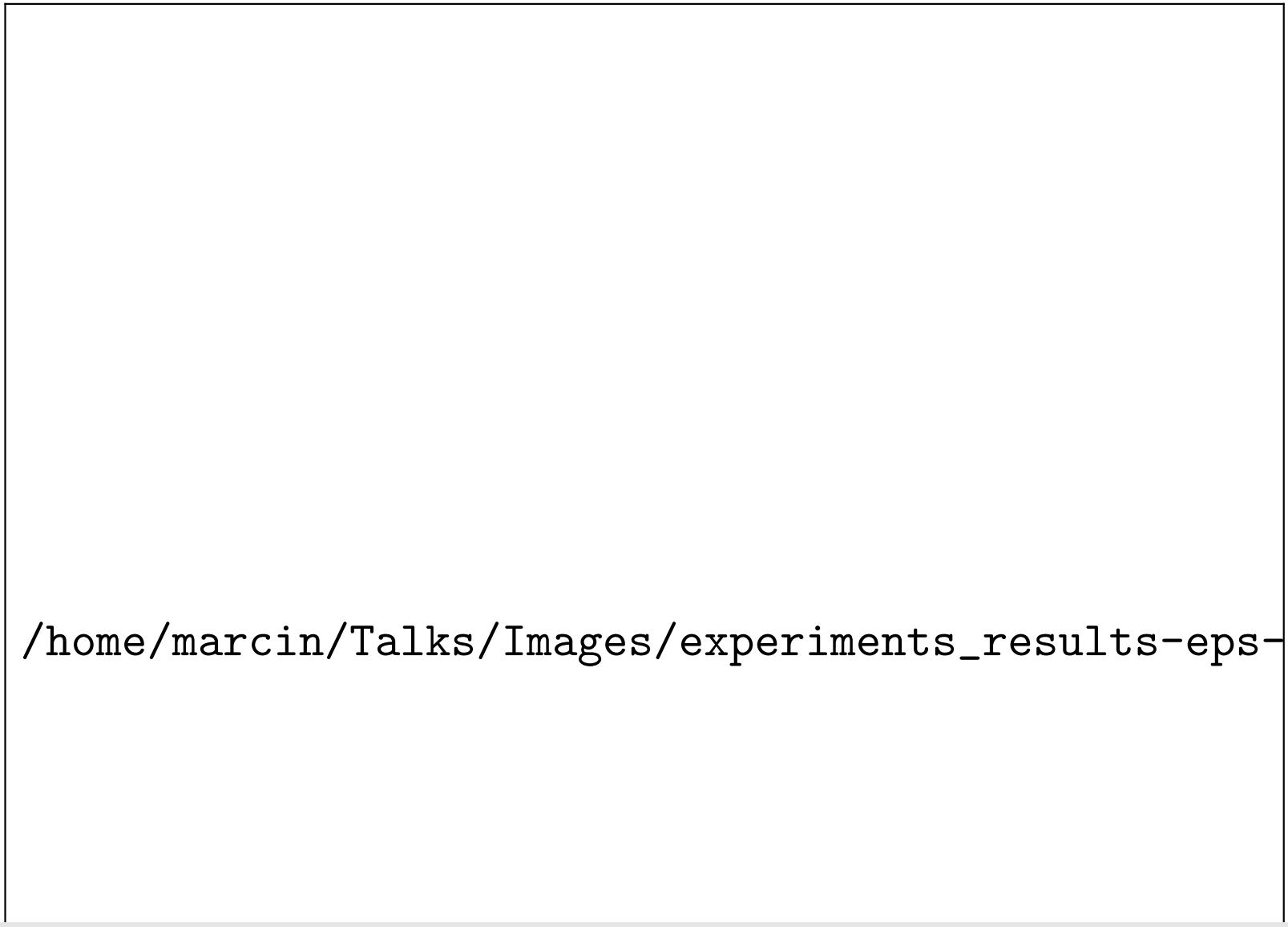
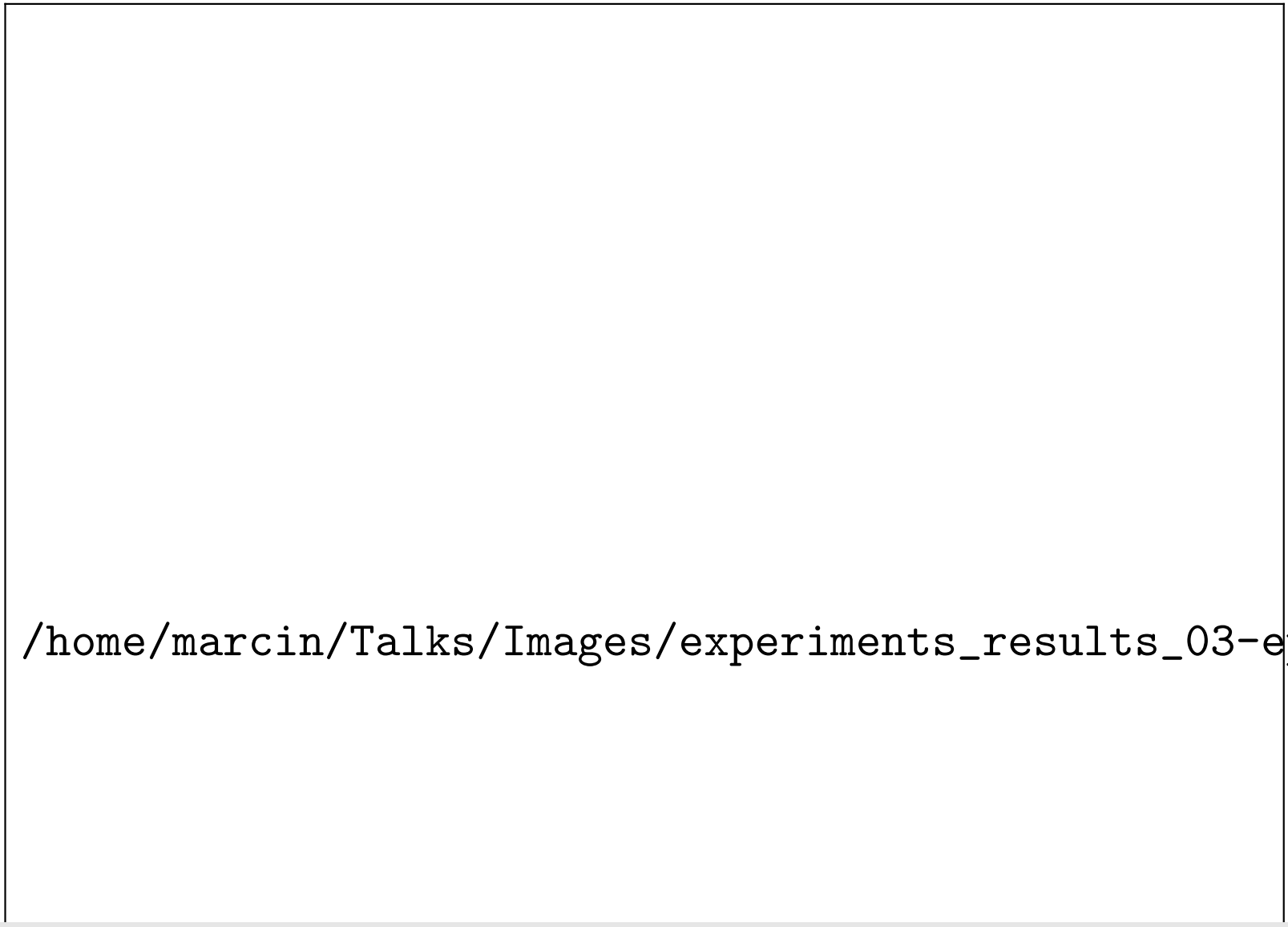
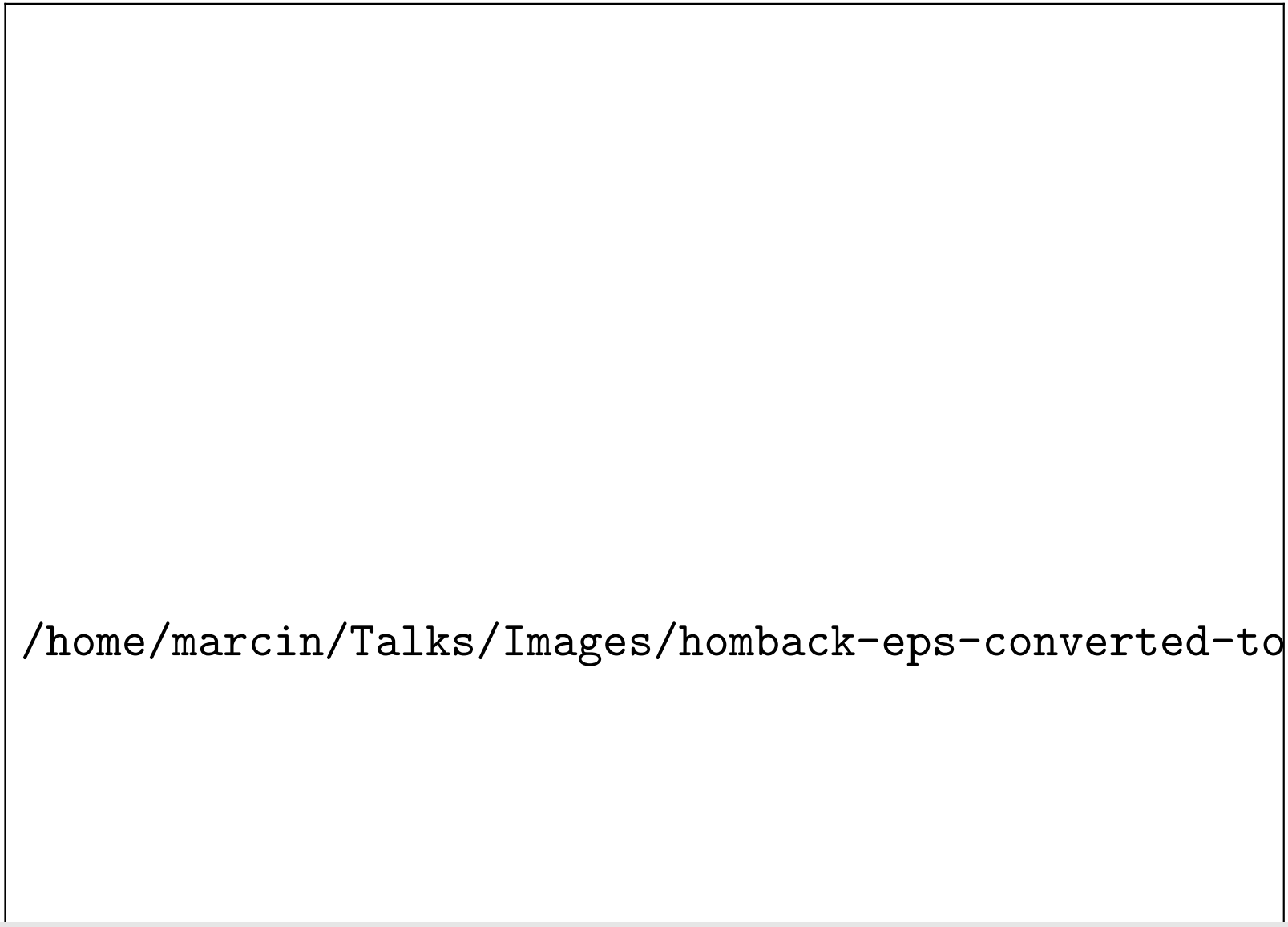


Image Database 3D-REAL-ENV

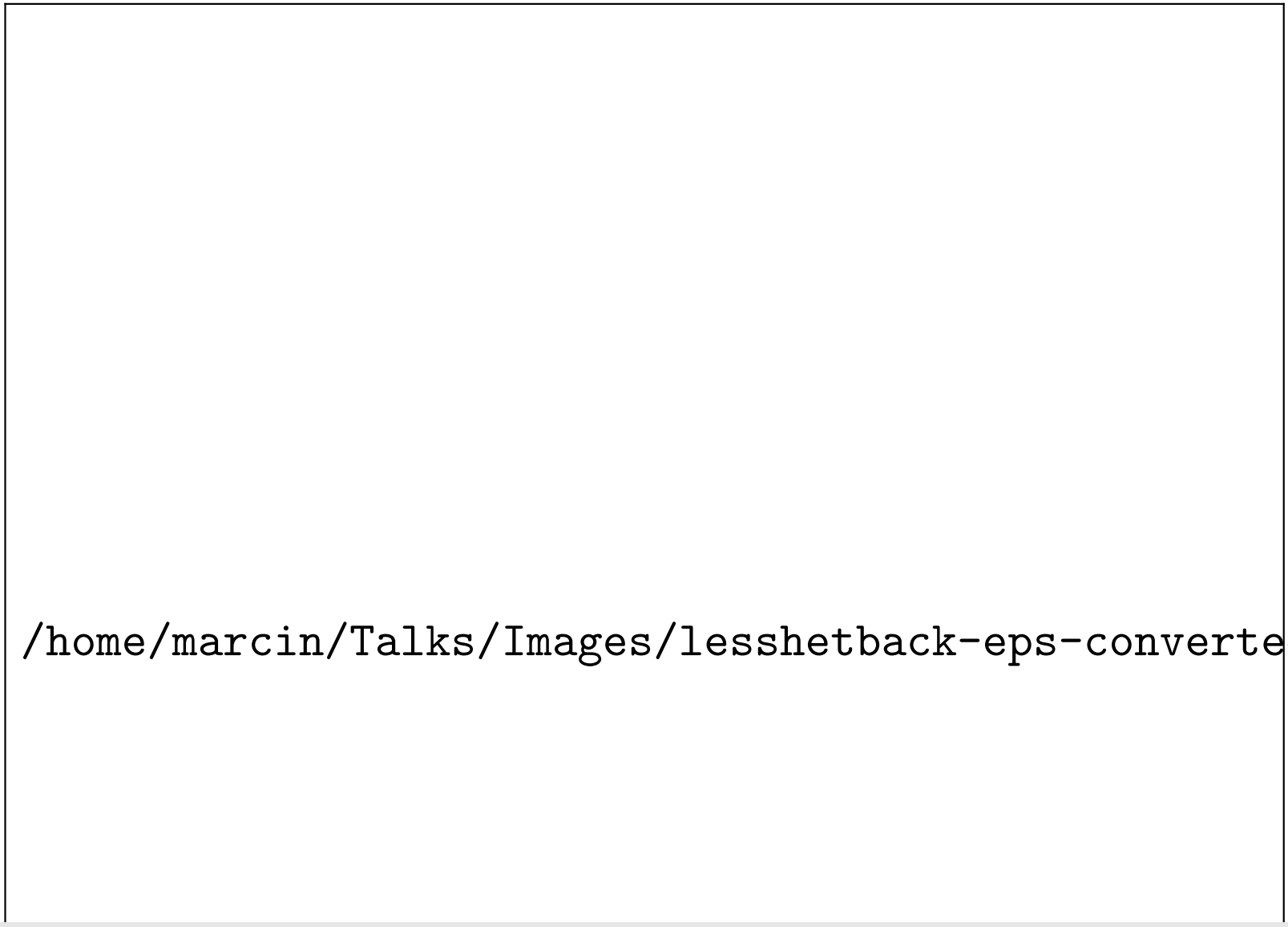


Training Images

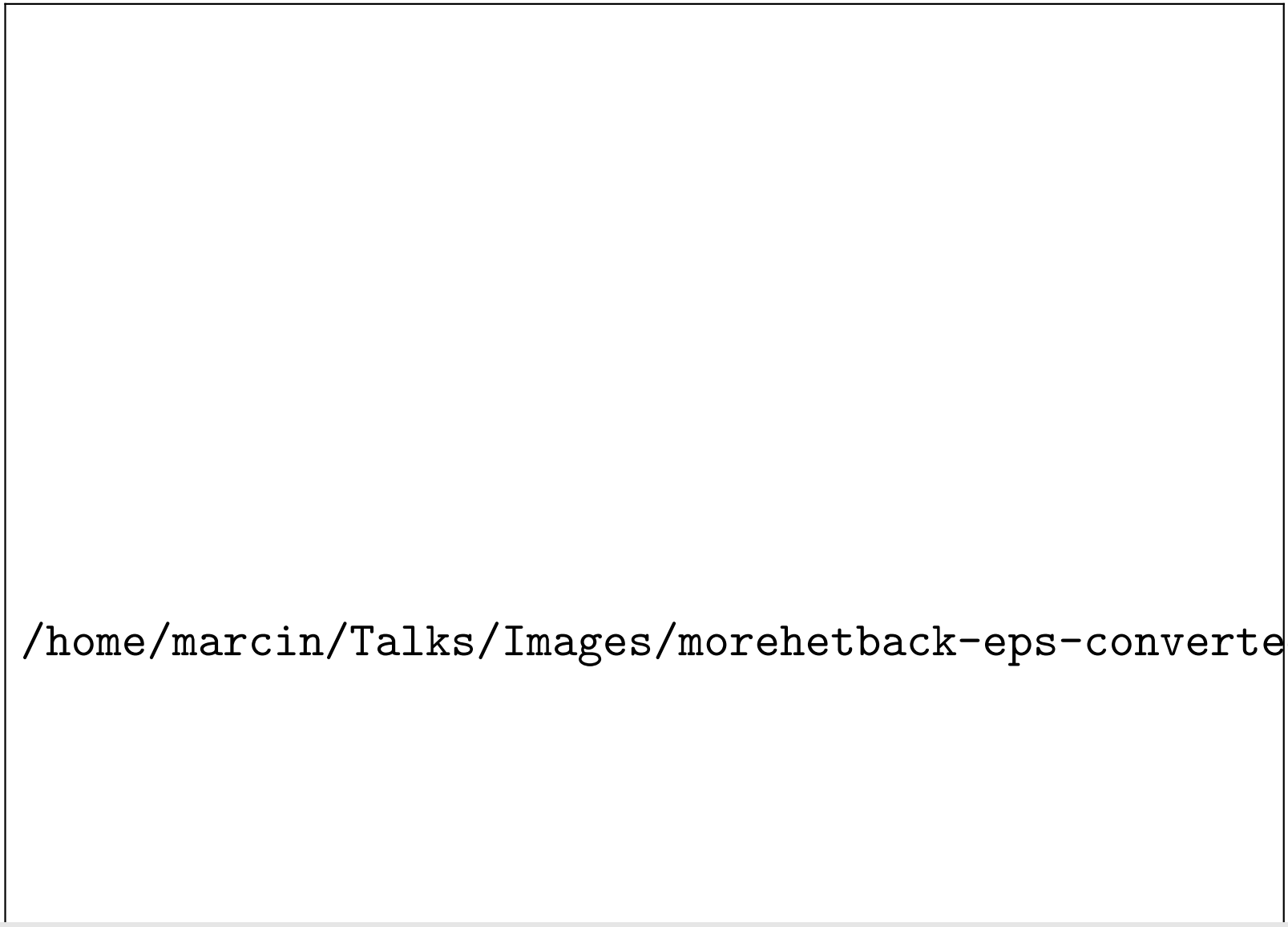
Test Images HomBack



Test Images LessHetBack



Test Images MoreHetBack



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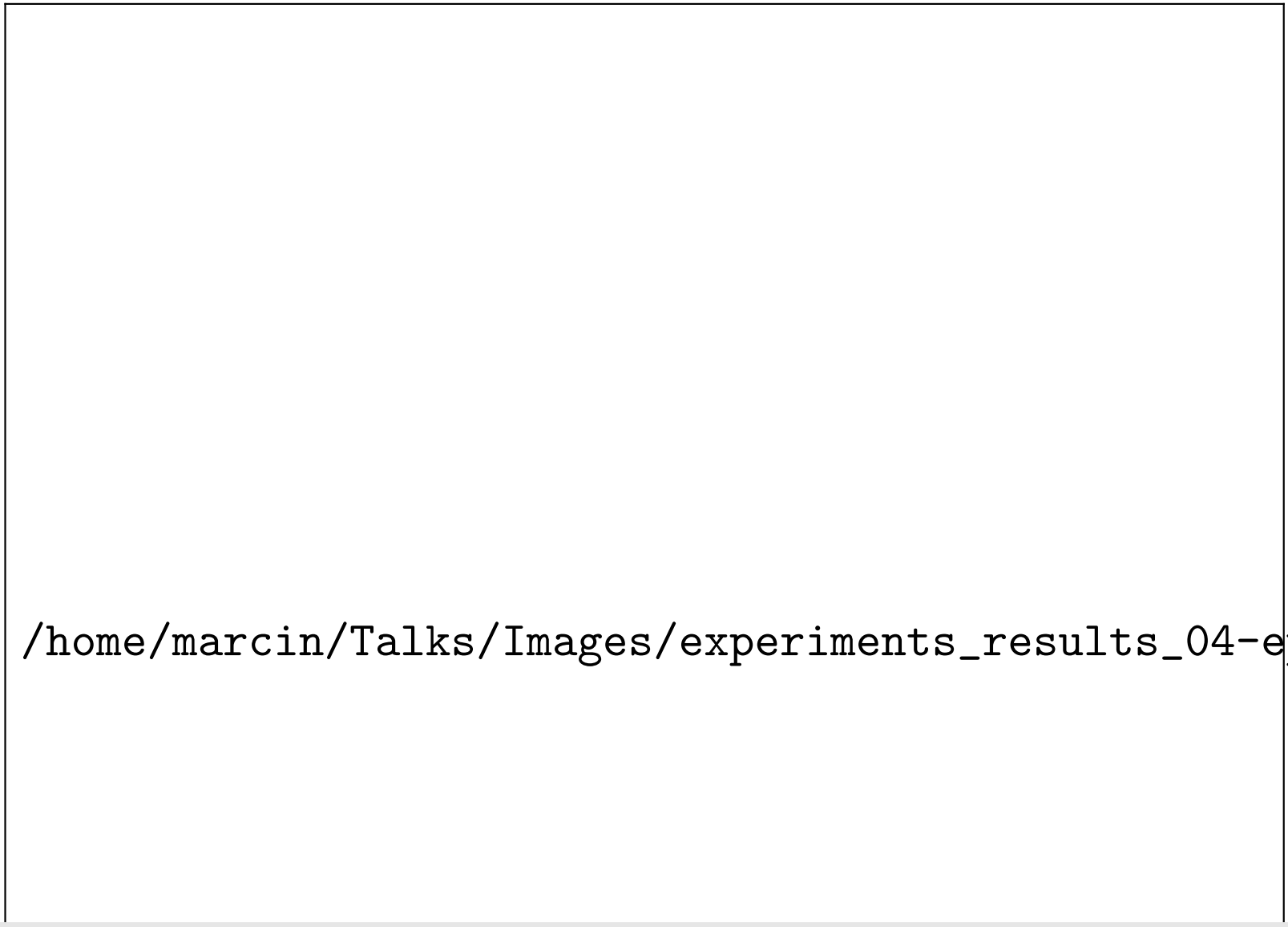
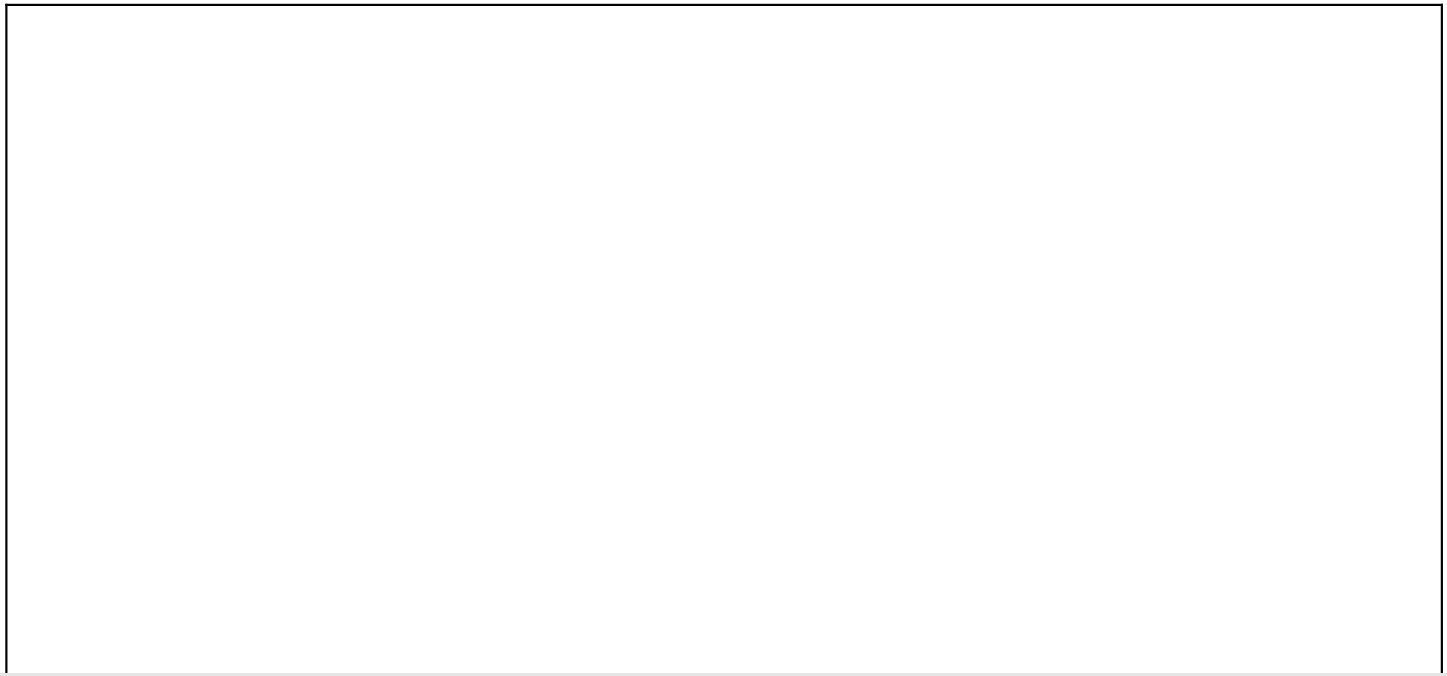


Classification and Localisation Rates

Distance of Training Views 4.5°	Classification			Localisation		
	Hom. Back.	Less Het. Back.	More Het. Back.	Hom. Back.	Less Het. Back.	More Het. Back.
Gray Level	100%	92.2%	54.1%	99.1%	80.9%	69.0%
Colour	100%	88.0%	82.3%	98.5%	77.8%	73.6%



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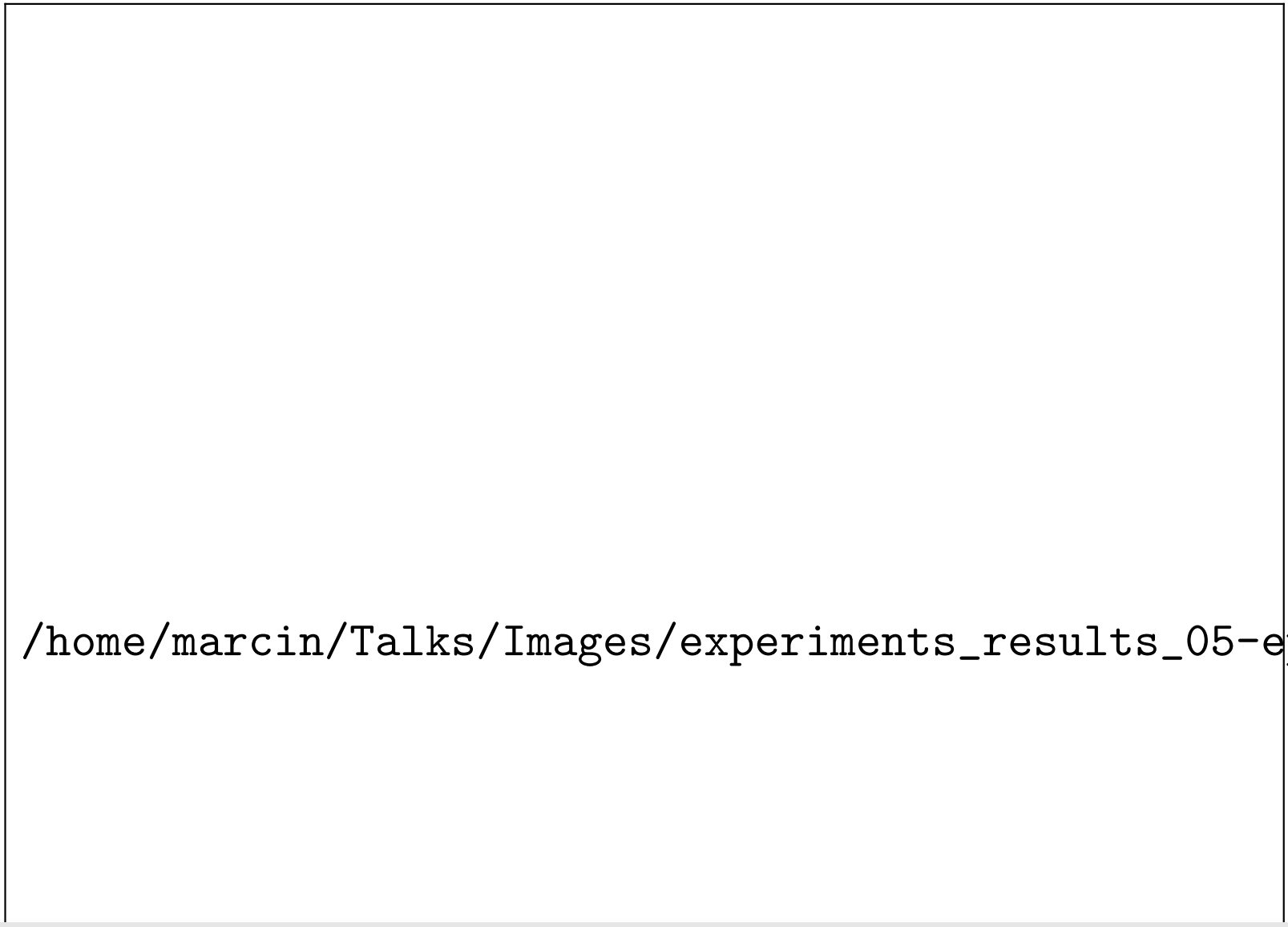
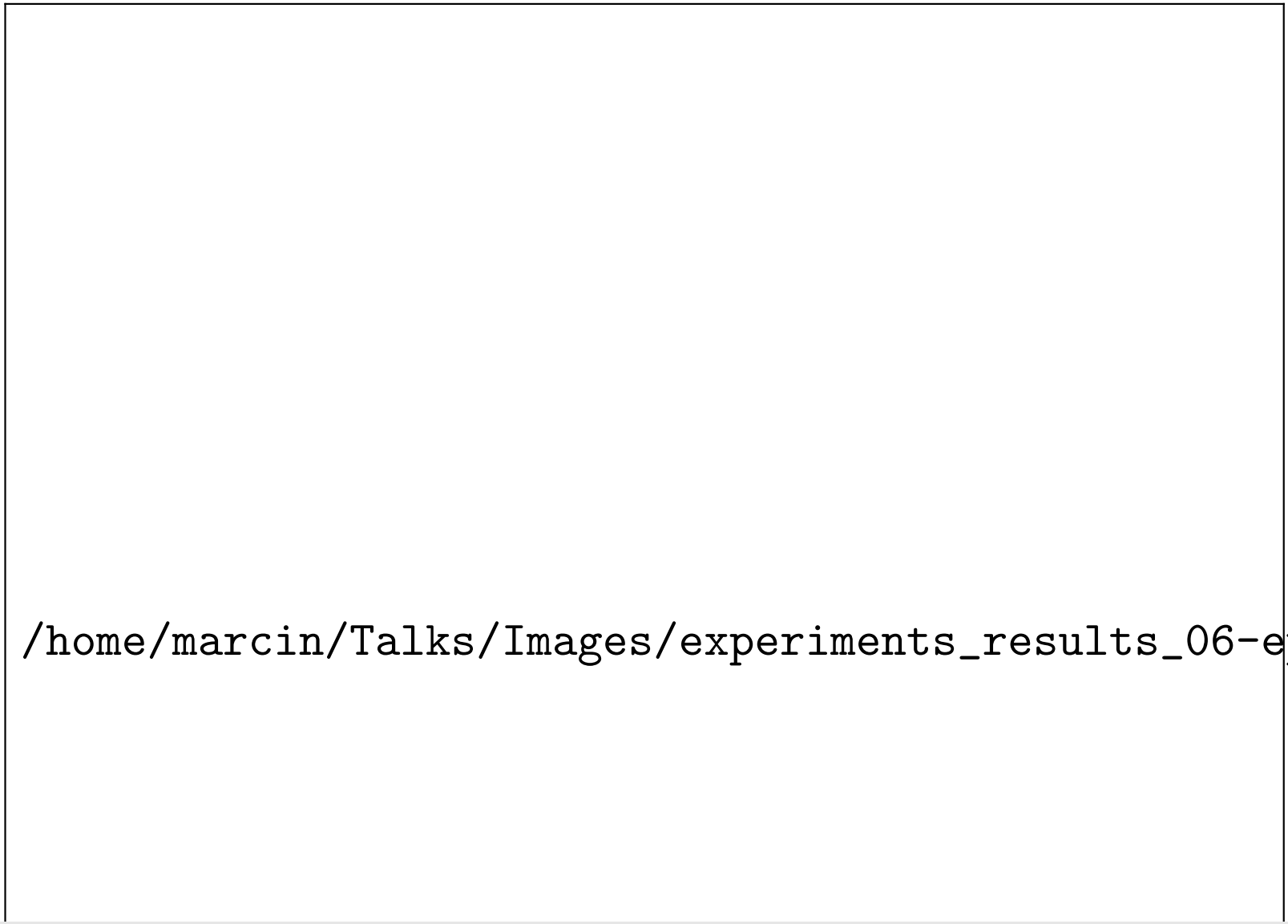
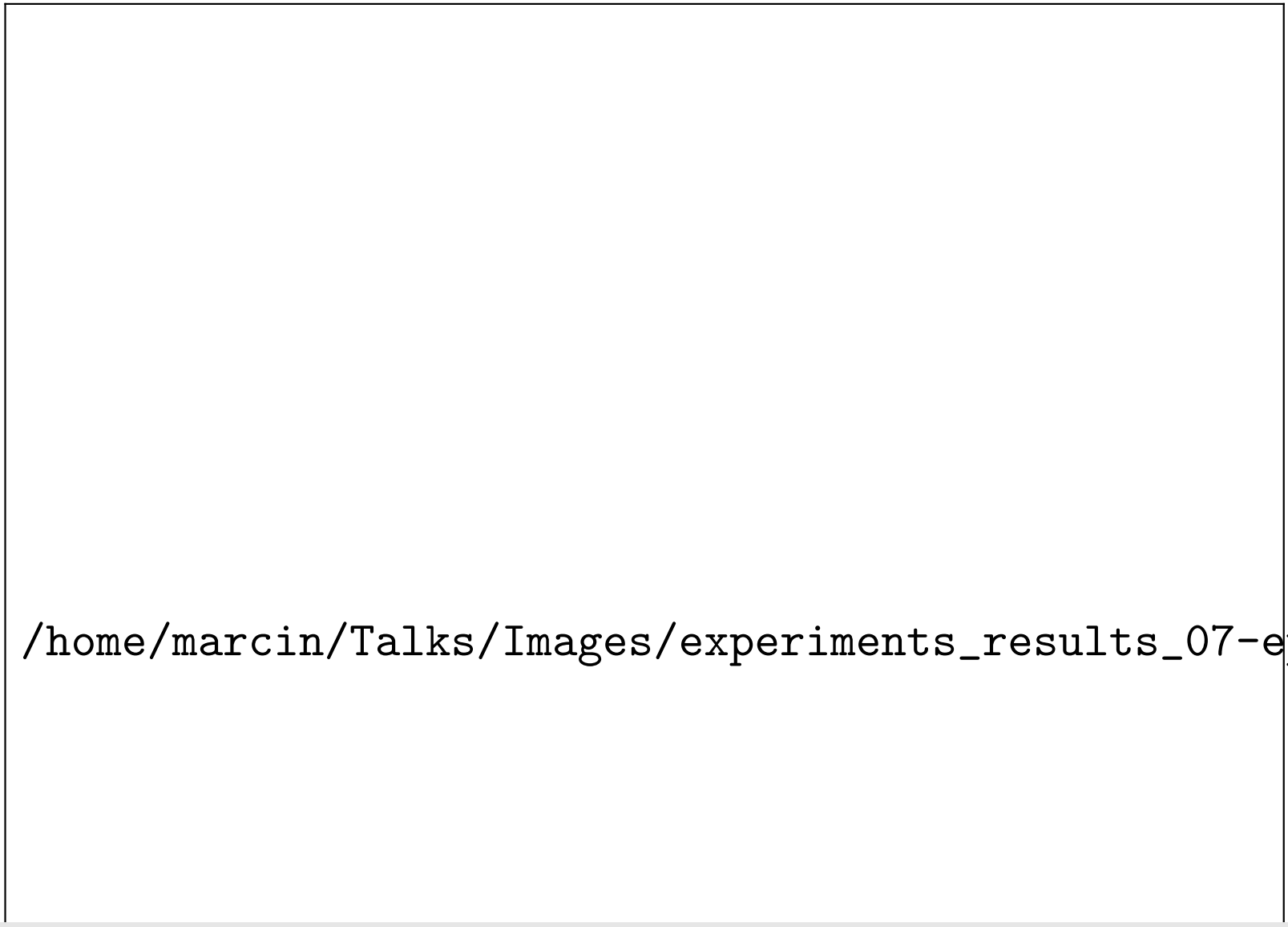


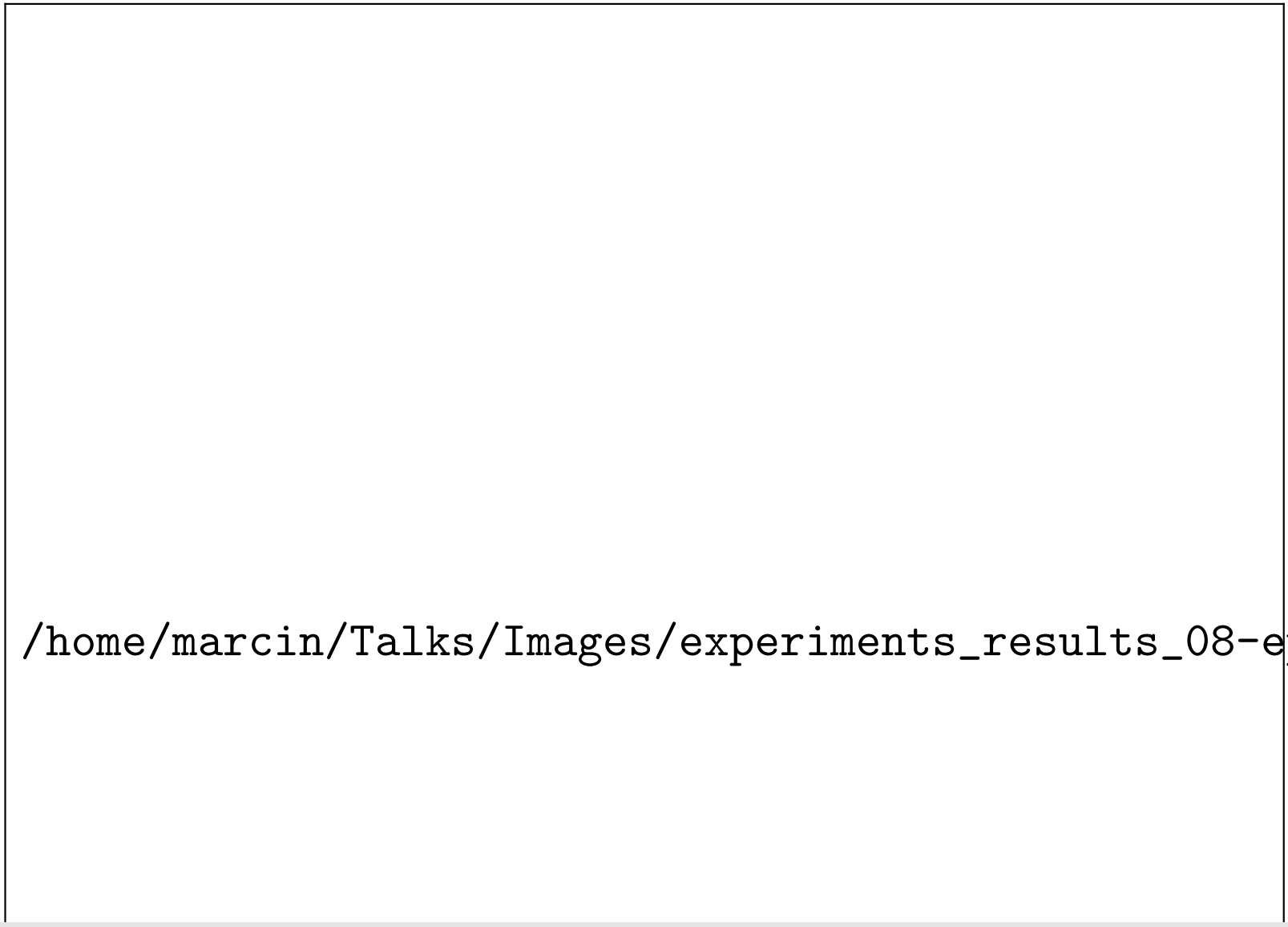
Multi-Object, Without Context



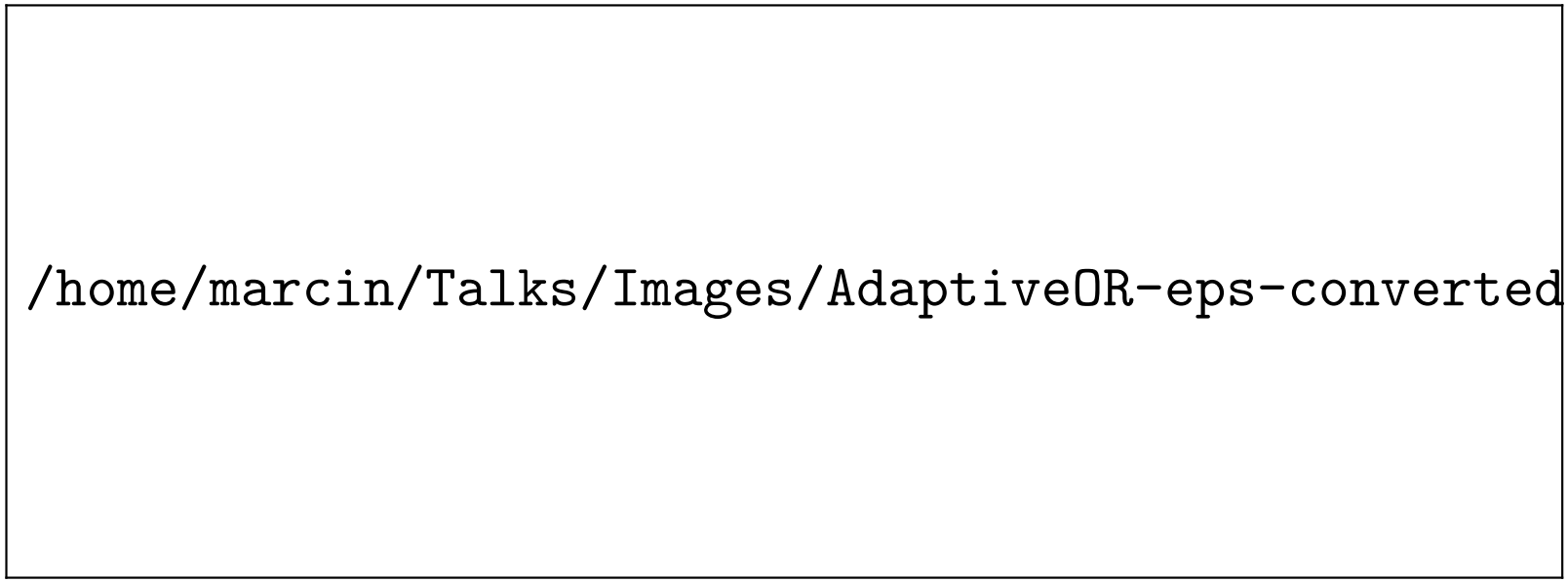
Multi-Object, With Context



Evaluation Completed



Adaptive Learning for Object Recognition



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Existing Collaborations

Multimodal Object Recognition and Scene Analysis

- Prof. Ryszard Tadeusiewicz, AGH Krakw
- Prof. Longin Jan Latecki, Temple University in Philadelphia
- Prof. Walter Kropatsch, Vienna University of Technology
- Prof. Andreas Kolb, University of Siegen
- Prof. Rolf Lakaemper, Temple University in Philadelphia
- Prof. Dietrich Paulus, University of Koblenz-Landau
- Prof. Zygmunt Pizlo, Purdue University
- Prof. Frank Deinzer, University of Applied Sciences Würzburg

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- Prof. Grzegorz Nalepa, AGH Krakw
- Prof. Volker Blanz, University of Siegen
- Prof. Stefan Rüger, The Open University
- Prof. Christoph Ruland, University of Siegen
- Prof. Kuniaki Uehara, Kobe University
- Prof. Beihai Zhou, University of Technology Beijing

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- Prof. Jarek Krajewski, University of Wuppertal
- Prof. Elmar Nöth, University of Erlangen-Nuremberg
- Prof. Steffen Staab, University of Koblenz-Landau
- Prof. Veit Braun, Neurosurgery Department, Jung-Stilling Hospital Siegen

Long-Term Scientific Vision