# Melanoma or Not Melanoma

A Pre-Trained CNN Model with 95% validation accuracy

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# Warning - due to the nature of this topic, there will be graphic images of skin lesions displayed in this presentation.

# Problem Statement

Skin cancer is the most common cancer in the U.S. and worldwide, of which melanoma is the most dangerous.

# Problem Statement

If left untreated, melanoma will typically spread to other areas of the body, including organs, making it a deadly metastatic cancer.

## Problem Statement

# Men are twice as likely as women to die of melanoma

## Problem Statement

However, with early detection, a person has a 99% survival rate

## Problem Statement

A smartphone app that can detect skin cancer is one method that could help with early detection.

## Problem Statement

Someone who gets a positive reading using the app, would likely be highly motivated to book a doctor's appointment right away.

## Problem Statement

The doctor may agree or disagree with the smartphone app’s “diagnosis”.

## Problem Statement

Regardless, the patient will have been proactive with his/her health and be in a position to take the necessary steps towards treatment.

# Stats - Part 1

**According to Data Compiled by The Skin Cancer Foundation:**

- 1 in 5 Americans will develop skin cancer by the age of 70.
- More than 2 people die of skin cancer in the U.S. every hour.
- Having 5 or more sunburns doubles your risk for melanoma.
- When detected early, the 5-year survival rate for melanoma is 99%.

# Stats - Part 2

- 2010 – 2020:  47% increase of invasive melanoma

- 6,850 people estimated to die this year.

- 4,610 estimated men

- 2,240 estimated women.

# Stats - Part 3

- $8.1 billion  = The annual cost of treating skin cancers in the U.S.

- $4.8 billion = nonmelanoma skin cancers.

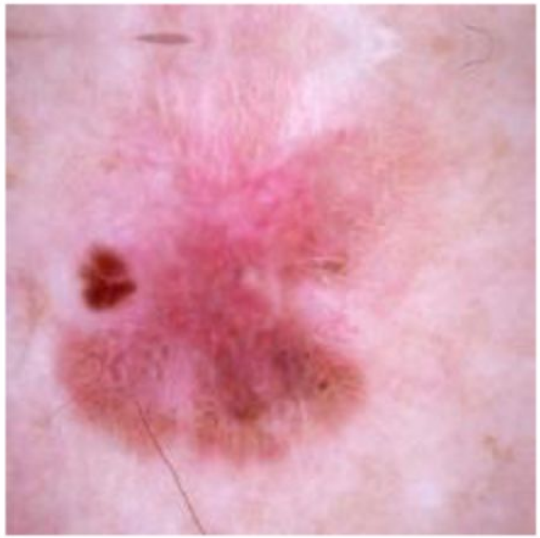
- $3.3 billion = melanoma.

# Stats - Part 4

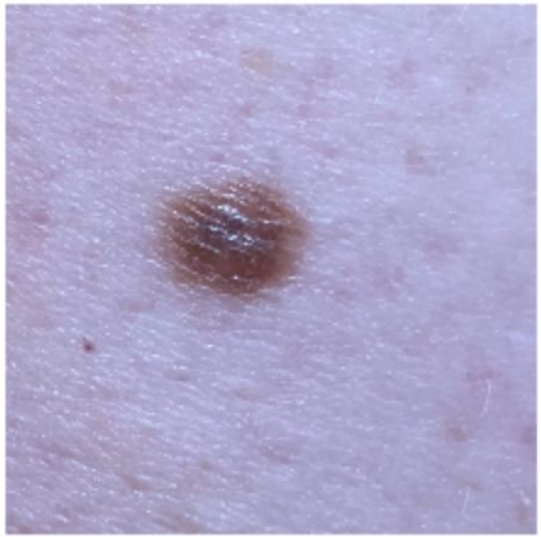
5-year Survival Rates of Melanoma in the United States:

- 92% average  across all stages of melanoma
- 99% for melanomas detected early
- 65% if it metastasizes  to lymph nodes
- 25%  if it metastasizes to distant organs.

# Build a model that can detect Melanoma with nearly 95% accuracy



The Results Are In:
There is a 99.99% likelihood
that this **IS** a Melanoma.



The Results Are In:
There is a 95.61% likelihood
that this is *NOT* a Melanoma.

# What is Melanoma Anyway?

## mel·a·no·ma

/ˌmelәˈnōmә/

1. a tumor of melanin-forming cells, especially a malignant tumor associated with skin cancer.
   "melanomas can appear anywhere on the body"[2]

# Diagnosing Melanoma is as simple as ABCDE

A. **Asymmetry** - 1/2 of the mole is different than other 1/2
B. **Border** - irregularity
C. **Color** - not uniform
D. **Diameter** - greater than 6 mm in size (pencil eraser)
E. **Evolving** - recent changes in size, shape or color.

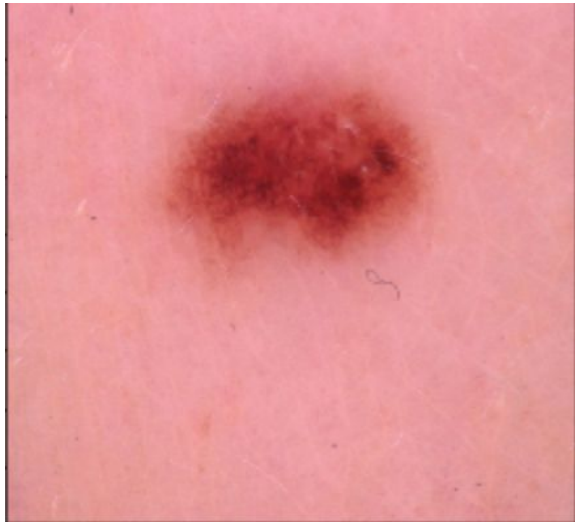
# Examples of ABC from Preventcancer.org

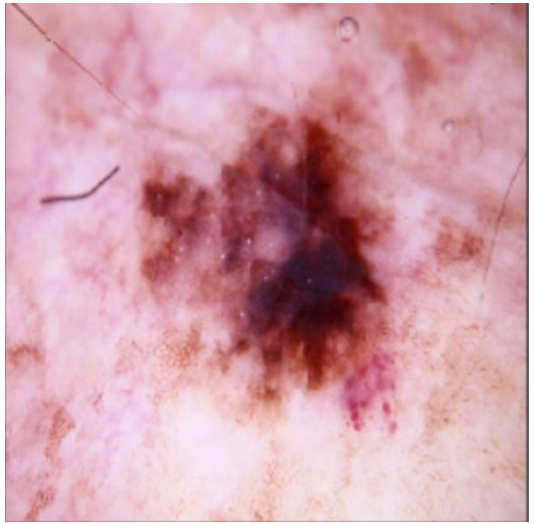
**Asymmetry**

**Borders**

**Color**

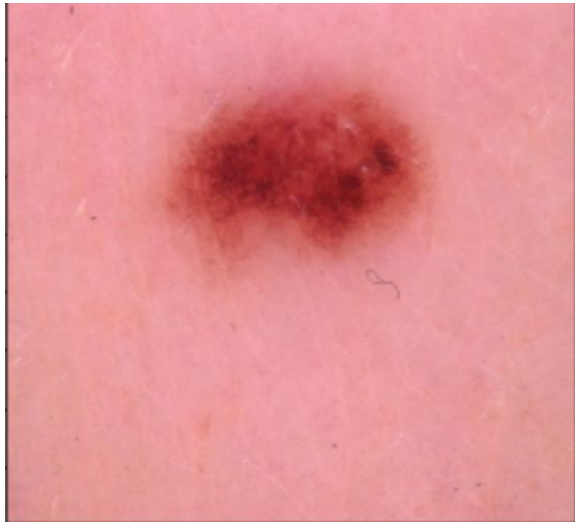
# Challenge: which of these 3 is a melanoma?



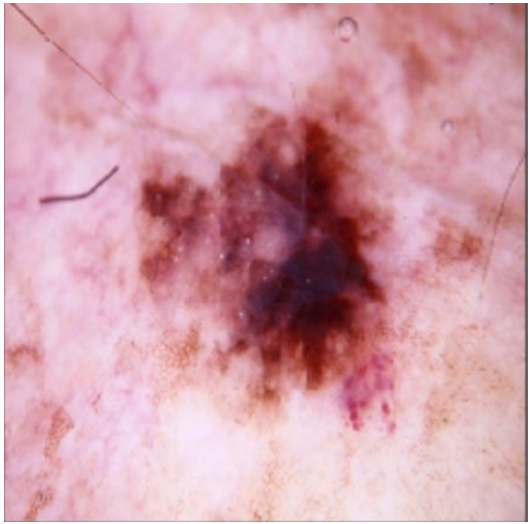


# Challenge: which of these 3 is a melanoma?

Negative



Positive



Negative

# The HAM10000 Dataset

Over 10,000 Images classified into 7 common pigmented skin lesions:

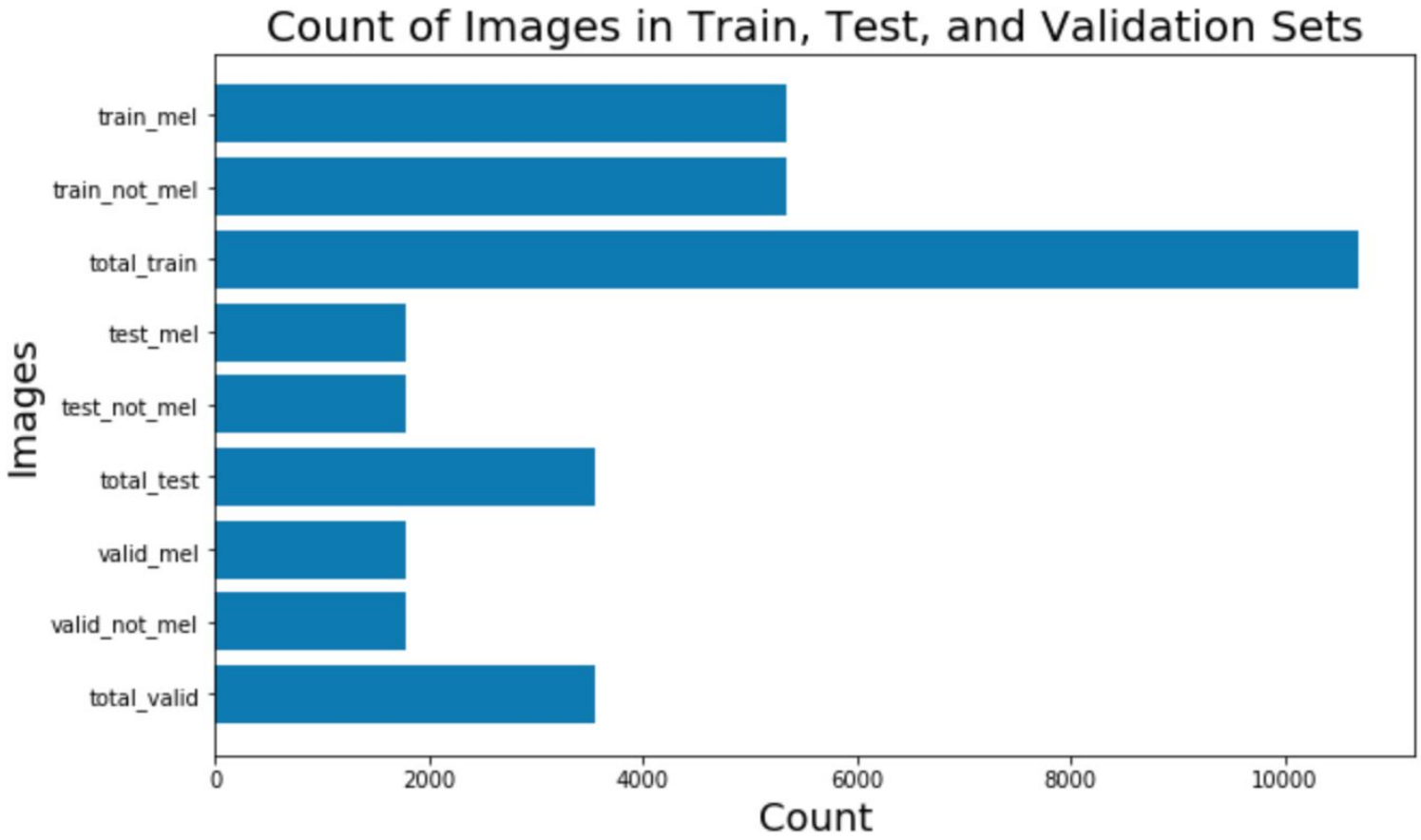
1. Actinic Keratoses
2. Basal cell carcinoma
3. Benign keratosis
4. Dermatofibroma
5. Melanocytic nevi
6. Melanoma
7. Vascular Skin Lesions

# The HAM10K Dataset

The dataset was then classified into 2 classes:

1. Melanoma
2. Not Melanoma

And uploaded to Kaggle.




Train - 10,682 images split into 2 classes

Test - 3,562 images split into 2 classes

Valid - 3,561 images split into 2 classes.

# The Model

A Convolutional Neural Network (CNN) that incorporates a pre-trained CNN model known as ResNet50.

## The Model

“ResNet-50 is trained on more than a million images from the ImageNet database. The network is 50 layers deep and can classify images into 1000 object categories, such as keyboard, mouse, pencil, and many animals.”[3]

# The Model

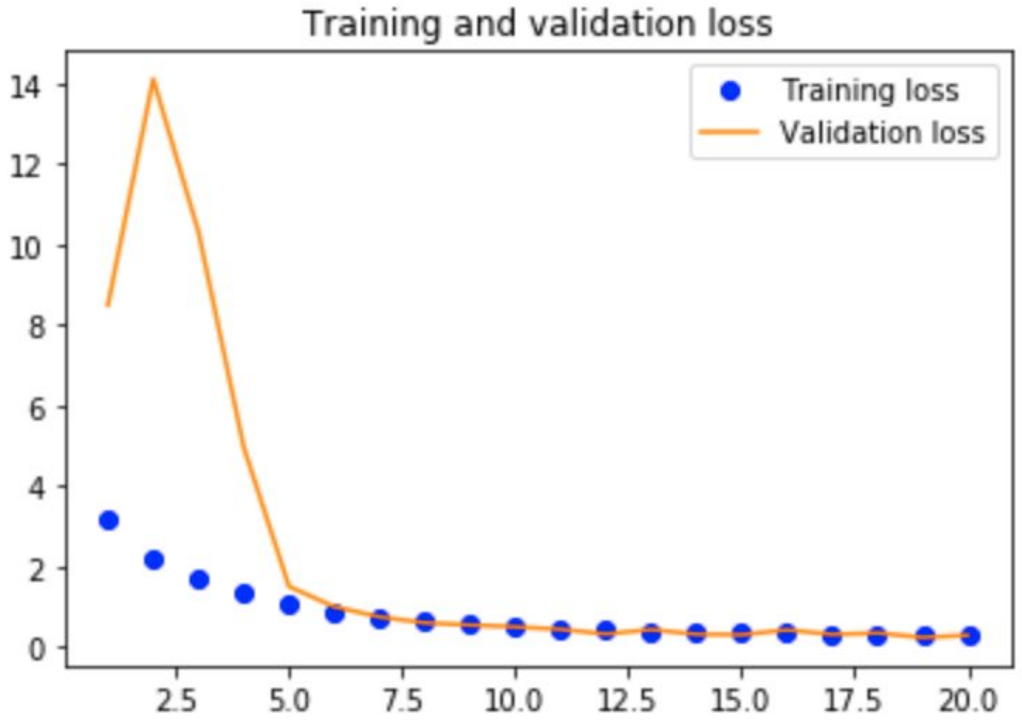
- Sequential  Model
- ResNet50 - 176 total layers
- Flatten Layer
- Dropout Layer - rate = 0.4
- Dense Layer with 562 neurons, relu activation, L2 rg - 0.003 penalty
- Dropout layer - rate = 0.3
- Dense layer with 2 neurons and Sigmoid Activation
- 79,987,224 total parameters

# The Model

After 20 epochs, the validation loss score was 0.29

The **loss** value implies how poorly or well a model behaves after each iteration.

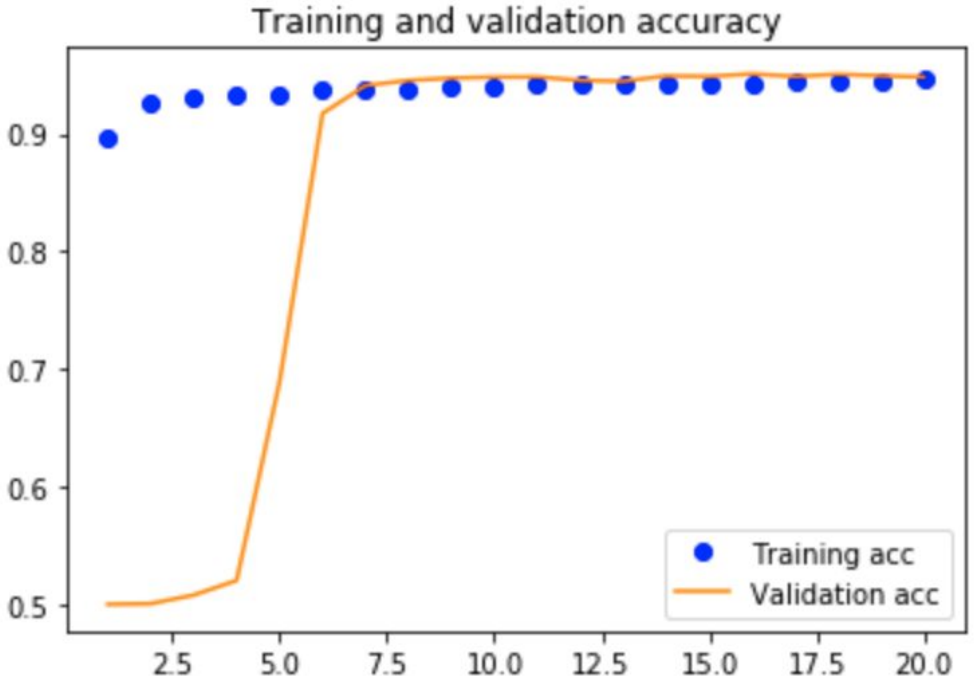
In this case very well.



# The Model

After 20 epochs, the validation accuracy score was 0.948

**Accuracy** = Number of correct predictions / Total number of predictions.



# Basic CNN model for comparison

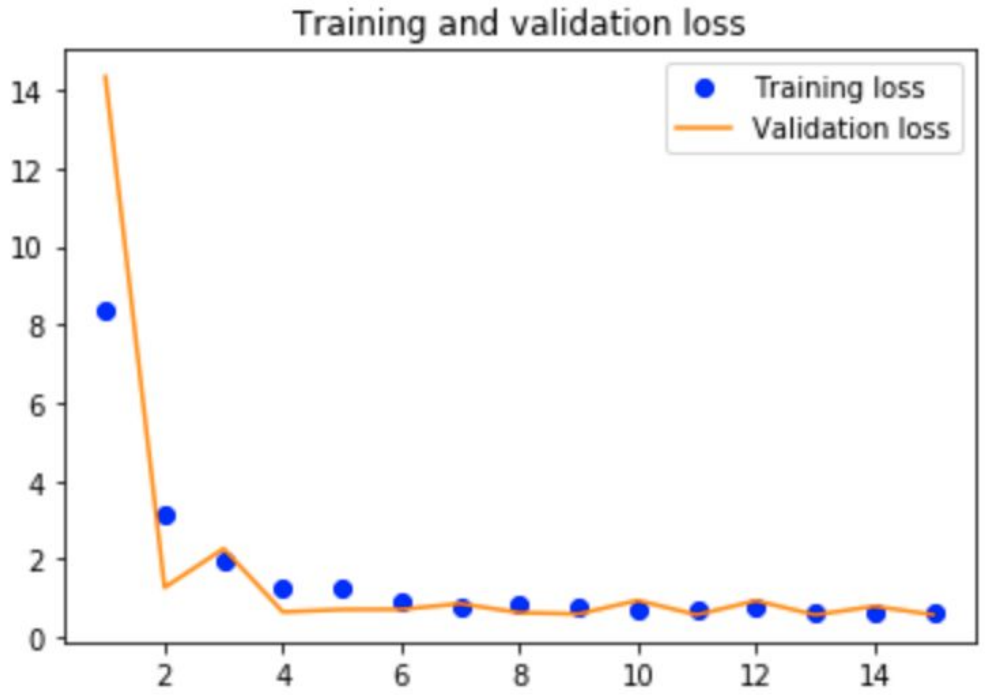
- Sequential  Model
- Flatten Layer
- Dropout Layer - rate = 0.4
- Dense Layer with 128 neurons, relu activation
- Dense Layer with 32 neurons, relu activation
- Dense Layer with 1 neuron, sigmoid activation
- 19,271,873 total parameters

# Model Comparison

After 15 epochs, the validation loss score was 0.57

The **loss** value implies how poor or well a model behaves after each iteration.

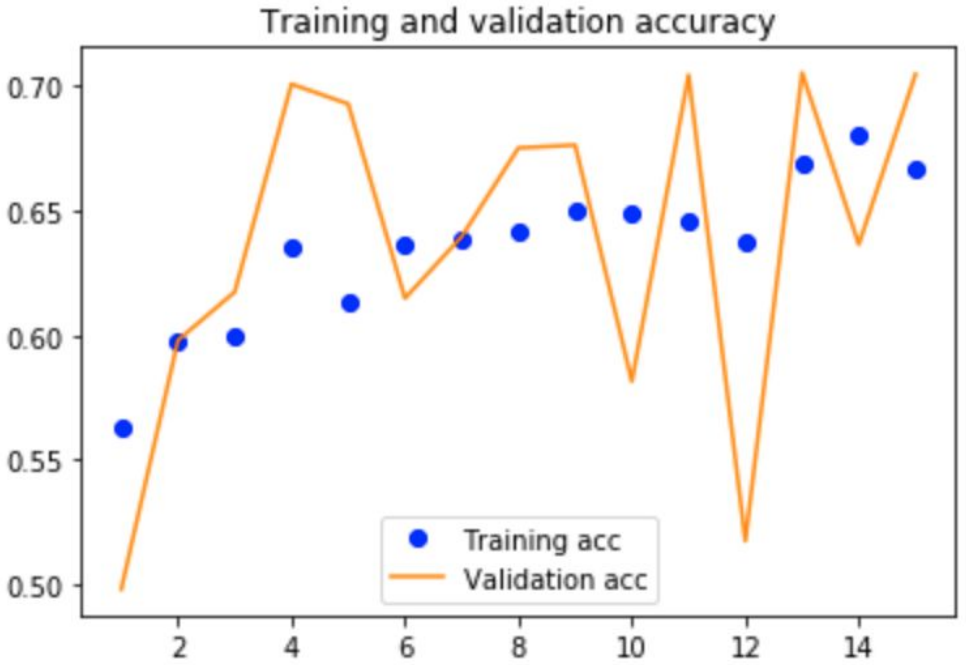
In this case pretty well



# Model Comparison

After 15 epochs, the validation accuracy score was 0.704

**Accuracy** = Number of correct predictions / Total number of predictions.



# Future possibilities to achieve even higher accuracy scores

1. More data that uses  smartphone pictures people upload to the app.
2. New and improved Machine Learning Models
3. Train a model on enhanced images such as those created by Dermoscopy

# Future possibilities to achieve even higher accuracy scores

**Dermoscopy** - “an office technique in which a magnifier is placed on skin that is covered with liquid. By using cross-polarized light, it is possible to see structures in the epidermis and superficial dermis that are not visible to the naked eye, thus allowing for better recognition of the ABCD signs of melanoma.”[4]

## Stretch Goals

1. Create an iphone/android app in conjunction with a sofware engineer and a UX designer
2. Deploy to the app store and create social media awareness for the app.
3. Make it like Venmo such that you can see when your friends uploaded pictures of their moles.

## Stretch Goals

Use this app as inspiration to create more health apps that utilize machine learning.

# Sources


1. The Skin Cancer Foundation - https://www.skincancer.org/skin-cancer-information/skin-cancer-facts/
2. Google dictionary definition of Melanoma
3. ResNet50 definition - https://www.mathworks.com/help/deeplearning/ref/resnet50.html
4. Dermoscopy definition - https://www.aafp.org/afp/2008/1115/p1205.html