

# 1<sup>st</sup> Lecture - <https://ai-ecu.github.io/HIT>

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- “Artificial Intelligence/Machine Learning for Image Analysis and Robotics” – course title but maybe mostly I’ll abbreviate to “AI”  
😊
- Introduction – who am I – where am I from?
- What is AI/ML/CV/Image Analysis/Robotics – what can it do - what is this course
- A little bit of theory/conceptual framework – agents, rational agents, utility.

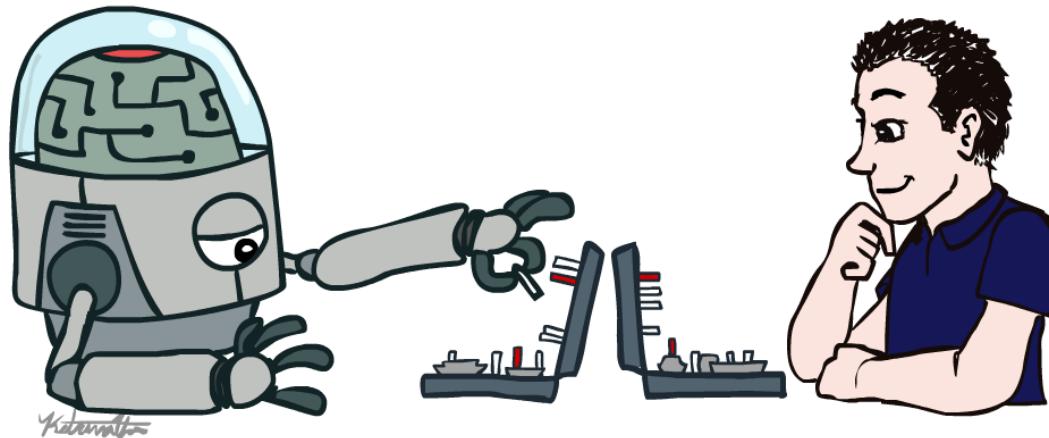
# Search, classification, model fitting

- These are all topics somewhat covered elsewhere:
  - Search (particularly tree search) in algorithms and data structure courses
  - Classification – in statistics, and of course in machine learning and data mining
  - Regression/Model Fitting – ditto
  - Optimal decision making – Economics, control, etc.

This course brings an AI perspective – alternatively one could turn it around and say much of AI can be treated as applied stats.

Search, classification, model fitting: AI perspective.

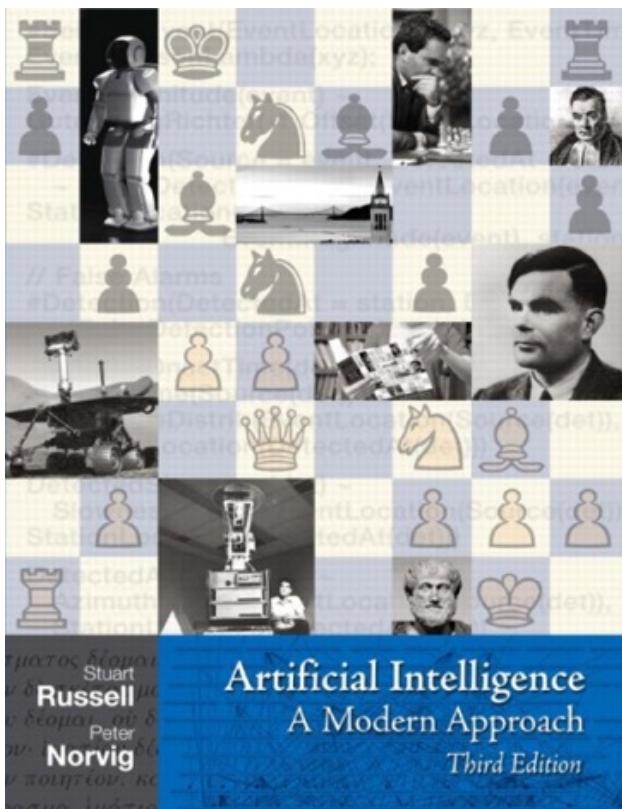
## Introduction



[Many slides adapted from those created by Dan Klein and Pieter Abbeel for CS188 Intro to AI at UC Berkeley. Some others from colleagues at Adelaide University.]

# Textbook

Russell & Norvig, AI: A Modern Approach, 3<sup>rd</sup> Ed.



## Product details

**Paperback:** 1152 pages

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**Language:** English

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**Shipping Weight:** 0.2 ounces ([View shipping rates and policies](#))

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**Amazon Best Sellers Rank:** #2,318,672 in Books ([See Top 100 in Books](#))

#790 in [Artificial Intelligence \(Books\)](#)

#2319 in [Artificial Intelligence & Semantics](#)

## Some Parts also from

- Analysis of Boolean Functions (e.g., Chapters 1 and 4 relevant)  
Ryan O'Donnell <http://analysisofbooleanfunctions.net>
- The Maximum Consensus Problem: Recent Algorithmic Advances  
Tat-Jun Chin, David Suter
- ISBN: 9781627052924 | PDF ISBN: 9781627052863
- Copyright © 2017 | 194 Pages
- DOI: 10.2200/S00757ED1V01Y201702COV011

# Resources

The “current Stanford Course” (like this one, highly influenced by the Berkeley Course and textbook).

<https://web.stanford.edu/class/cs221/>

Big Data Analytics (EdX – free to enroll and basic materials) <https://www.edx.org/course/big-data-analytics>

Section 1: Simple linear regression: Fit a simple linear regression between two variables in R; Interpret output from R; Use models to predict a response variable; Validate the assumptions of the model.

Section 2: Modelling data: Adapt the simple linear regression model in R to deal with multiple variables; Incorporate continuous and categorical variables in their models; Select the best-fitting model by inspecting the R output.

Section 3: Many models: Manipulate nested dataframes in R; Use R to apply simultaneous linear models to large data frames by stratifying the data; Interpret the output of learner models.

Section 4: Classification: Adapt linear models to take into account when the response is a categorical variable; Implement Logistic regression (LR) in R; Implement Generalised linear models (GLMs) in R; Implement Linear discriminant analysis (LDA) in R.

Section 5: Prediction using models: Implement the principles of building a model to do prediction using classification; Split data into training and test sets, perform cross validation and model evaluation metrics; Use model selection for explaining data with models; Analyse the overfitting and bias-variance trade-off in prediction problems.

Section 6: Getting bigger: Set up and apply sparklyr; Use logical verbs in R by applying native sparklyr versions of the verbs.

Section 7: Supervised machine learning with sparklyr

Apply sparklyr to machine learning regression and classification models; Use machine learning models for prediction; Illustrate how distributed computing techniques can be used for “bigger” problems.

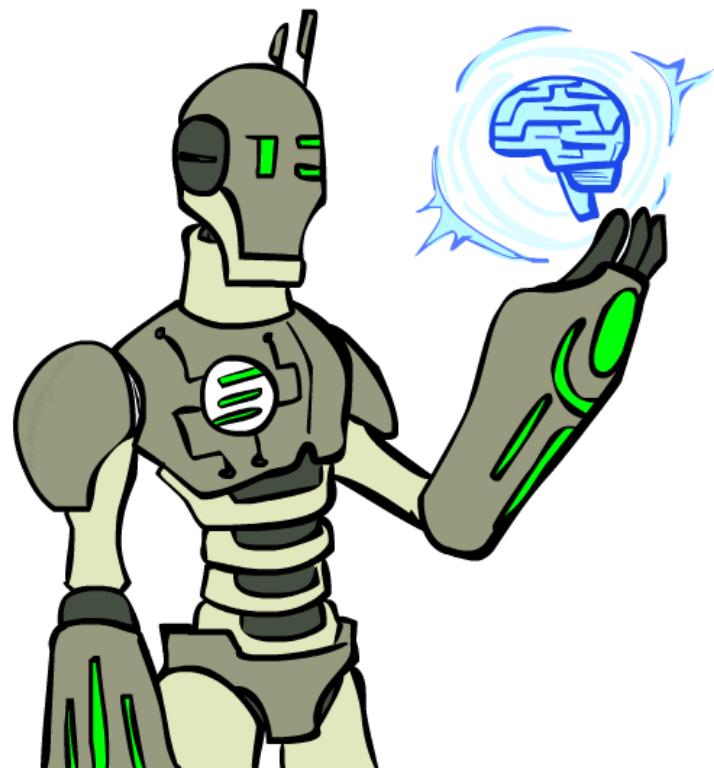
Section 8: Deep learning: Use massive amounts of data to train multi-layer networks for classification; Understand some of the guiding principles behind training deep networks, including the use of autoencoders, dropout, regularization, and early termination; Use sparklyr and H2O to train deep networks.

Section 9: Deep learning applications and scaling up: Understand some of the ways in which massive amounts of unlabelled data, and partially labelled data, is used to train neural network models; Leverage existing trained networks for targeting new applications; Implement architectures for object classification and object detection and assess their effectiveness.

Plenty of online sources.... **web search....**

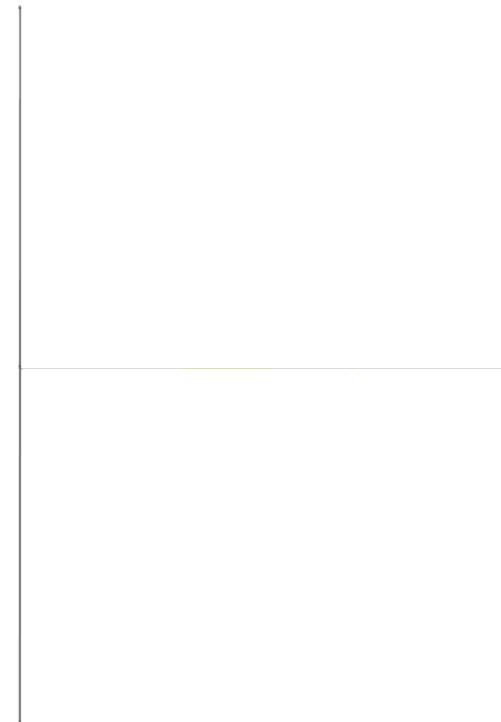
# First Things

- What is artificial intelligence?
- What can AI do?
- AI is HERE!
- What is this course?



# What is AI?

The science of making machines that:



# What is AI?

The science of making machines that:

<b>Thinking Humanly</b> <p>“The exciting new effort to make computers think . . . <i>machines with minds</i>, in the full and literal sense.” (Haugeland, 1985)</p> <p>“[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . .” (Bellman, 1978)</p>	<b>Thinking Rationally</b> <p>“The study of mental faculties through the use of computational models.” (Charniak and McDermott, 1985)</p> <p>“The study of the computations that make it possible to perceive, reason, and act.” (Winston, 1992)</p>
<b>Acting Humanly</b> <p>“The art of creating machines that perform functions that require intelligence when performed by people.” (Kurzweil, 1990)</p> <p>“The study of how to make computers do things at which, at the moment, people are better.” (Rich and Knight, 1991)</p>	<b>Acting Rationally</b> <p>“Computational Intelligence is the study of the design of intelligent agents.” (Poole <i>et al.</i>, 1998)</p> <p>“AI . . . is concerned with intelligent behavior in artifacts.” (Nilsson, 1998)</p>
<b>Figure 1</b> Some definitions of artificial intelligence, organized into four categories.	

# Rational Decisions

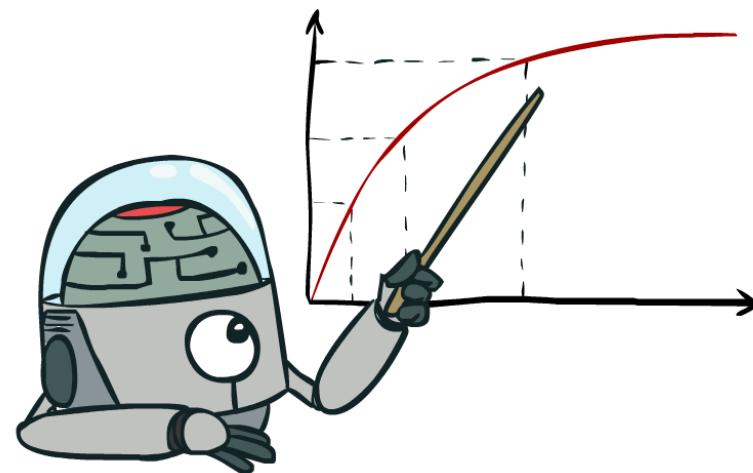
Norvig uses the term **rational** in a very specific, technical way:

- Rational: maximally achieving pre-defined goals
- Rationality only concerns what decisions are made  
(not the thought process behind them)
- Goals are expressed in terms of the **utility** of outcomes
- Being rational means **maximizing your expected utility**

Much of this course is about:

**Computational Rationality**

# Maximize Your Expected Utility

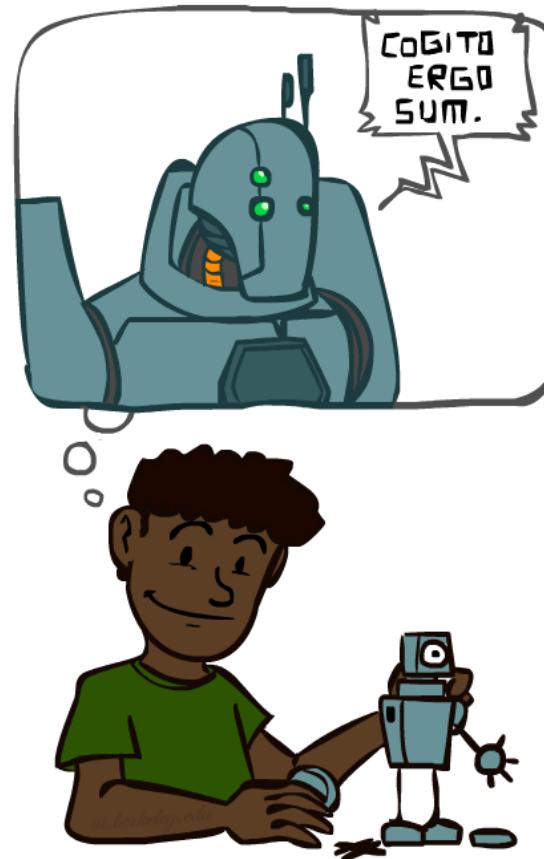


# What About the Brain?

- Brains (human minds) are very good at making rational decisions, but not perfect
- Brains aren't as modular as software, so hard to reverse engineer!
- “Brains are to intelligence as wings are to flight”
- Lessons learned from the brain: memory and simulation are key to decision making



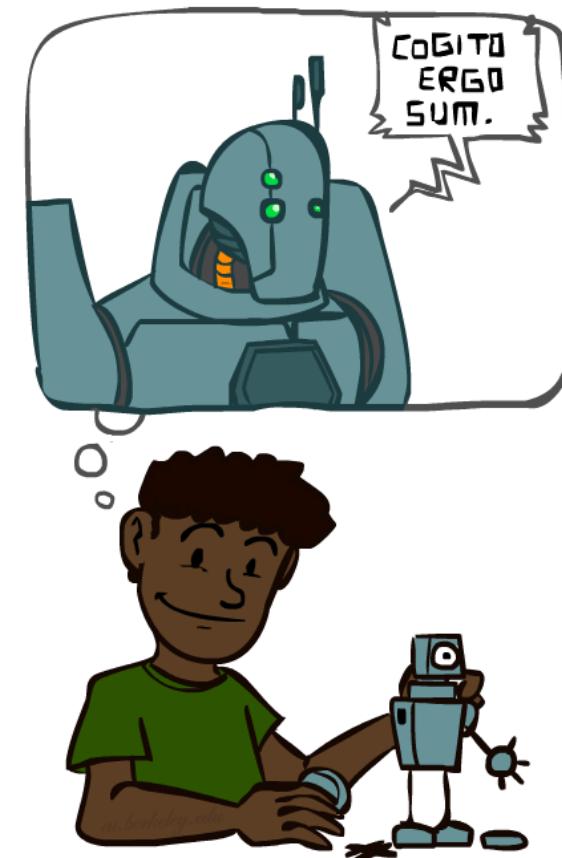
# A (Short) History of AI





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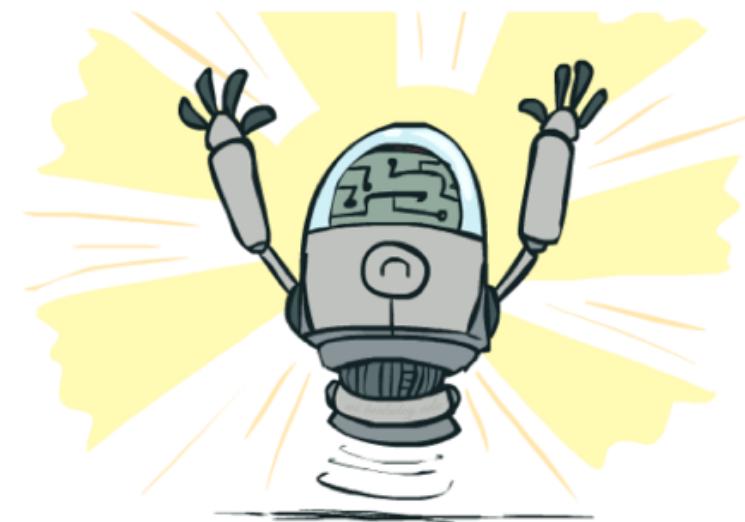
- 1940–1950: Early days
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing's "Computing Machinery and Intelligence"
- 1950–70: Excitement: Look, Ma, no hands!
  - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
  - 1956: Dartmouth meeting: "Artificial Intelligence" adopted
  - 1965: Robinson's complete algorithm for logical reasoning
- 1970–90: Knowledge-based approaches
  - 1969–79: Early development of knowledge-based systems
  - 1980–88: Expert systems industry booms
  - 1988–93: Expert systems industry busts: "AI Winter"
- 1990–: Statistical approaches
  - Resurgence of probability, focus on uncertainty
  - General increase in technical depth
  - Agents and learning systems... "AI Spring"?
- 2000–: Where are we now?
  - Deep Learning is definitely very popular.



# What Can AI Do?

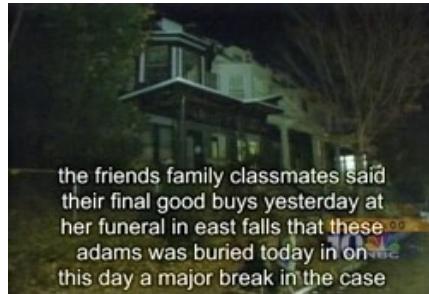
Quiz: Which of the following can be done at present?

- ✓ Play a decent game of table tennis?
- ✓ Play a decent game of Jeopardy?
- ✓ Drive safely along a curving mountain road?
- ✗ Drive safely along Complex Roads?
- ✓ Buy a week's worth of groceries on the web?
- ✗ Buy a week's worth of groceries at a physical store?
- ✗ Discover and prove a new mathematical theorem?
- ✗ Converse successfully with another person for an hour?
- ✓ Perform a surgical operation?
- ✓ Put away the dishes and fold the laundry?
- ✗ Translate spoken Chinese into spoken English in real time?
- Write an intentionally funny story?



# Natural Language

- Speech technologies (e.g. Siri)
  - Automatic speech recognition (ASR)
  - Text-to-speech synthesis (TTS)
  - Dialog systems



AI as seen from 1968 (film made) c.f. moon walk 1969, AI birth (1956?)



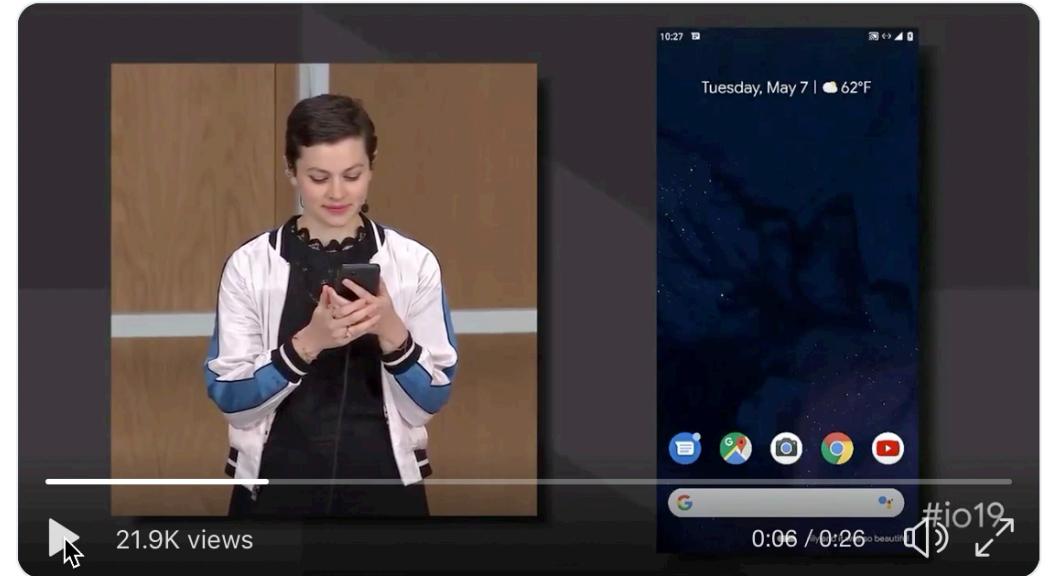
AI is here....service robots, chatbots and “assistants” are here...speech, *vision*, *spatial awareness*



Service  
Robot  
Xiamen,  
PRC, Nov  
2018

Google  
Major  
Announcem  
ents, May 7  
2019

So fast, you might've missed it. Running on-device, the next generation Google Assistant makes it easier to multitask across apps—so things like looking up answers, and finding and sharing a photo are faster than ever.  
**#io19**



Follow the money!...who's made/making money....where investing?

Rank	Name	Citizenship	Net worth (USD)	Age	Main source of wealth
1	Jeff Bezos	United States	\$152.0 billion ▲	55	Amazon.com
2	Bill Gates	United States	\$99.7 billion ▲	63	Microsoft
3	Bernard Arnault	France	\$89.1 billion ▲	69	LVMH
4	Warren Buffett	United States	\$88.5 billion ▲	88	Berkshire Hathaway
5	Amancio Ortega	Spain	\$67.5 billion ▲	82	Zara
6	Mark Zuckerberg	United States	\$65.4 billion ▲	34	Facebook
7	Larry Ellison	United States	\$65.4 billion ▲	74	Oracle
8	Carlos Slim	Mexico	\$63.2 billion ▼	78	América Móvil
9	Michael Bloomberg	United States	\$59.4 billion ▲	76	Bloomberg
11	Larry Page	United States	\$55.3 billion ▲	45	Google
10	Mukesh Ambani	India	\$58.7 billion ▲	62	Reliance Industries
12	Sergey Brin	United States	\$54.1 billion ▲	45	Google
13	Françoise Bettencourt Meyers	France	\$53.2 billion ▲	65	L'Oréal
14	Charles Koch	United States	\$52.0 billion ▲	83	Koch Industries
15	David Koch	United States	\$52.0 billion ▲	78	
16	Jim Walton	United States	\$45.9 billion ▲	70	
17	Alice Walton	United States	\$45.7 billion ▲	69	
18	S. Robson Walton	United States	\$45.6 billion ▲	74	
19	Steve Ballmer	United States	\$45.4 billion ▲	62	Microsoft
20	Ma Huateng	China	\$41.9 billion ▲	47	Tencent

Internet/Tech/Comms – invariably investing heavily in AI

Fashion/Retail – and what is a common target of AI startups?

Source Wikipedia

Follow the money! – what was it like in 1957?

## Fortune's Wealthiest Americans (1957) [\[ edit \]](#)

In 1957, *Fortune* magazine developed a list of the seventy-six *wealthiest Americans*, which was republished in many American newspapers.

Getty, when asked his reaction on being named *wealthiest American* and whether he was really worth a billion dollars, said "You know, if you can count your money, you don't have a billion dollars" and then famously added, "But remember, a billion dollars isn't worth what it used to be."<sup>[2]</sup>

\$700,000,000 to \$1,000,000,000

- Jean Paul Getty, Oil; business headquarters is in Los Angeles, California.

\$400,000,000 to \$700,000,000

- Mrs Mellon Bruce, the former Ailsa Mellon, New York, New York. Inherited wealth: Mellon Bank, Gulf Oil Company, Alcoa
- Arthur Vining Davis, Miami, Florida; Alcoa, Florida real estate.,
- H. L. Hunt, Dallas, Texas; independent oil operator.
- Paul Mellon, Upperville, Virginia; inherited wealth.
- Richard King Mellon, Pittsburgh, Pennsylvania; inherited wealth: Alcoa, Gulf Oil, Mellon Bank, etc
- John D. Rockefeller Jr., New York inherited wealth: Standard Oil Trust
- Mrs. Alan M. Scaife, the former Sarah Mellon, Pittsburgh. Inherited wealth.

\$200,000,000 to \$400,000,000

- Irénée du Pont, Wilmington, Delaware and Cuba; inherited wealth: E. I du Pont de Nemours & Co.
- William du Pont Jr., Wilmington; inherited wealth: E. I du Pont de Nemours & Co.
- Mrs. Frederick Guest, the former Amy Phipps, Palm Beach, Florida. Inherited wealth.
- Howard Hughes, Los Angeles; inherited wealth: Hughes Tool Company.
- Joseph P. Kennedy, Boston, Massachusetts-New York; real estate.

