

# Towards Large-Scale Collaborative Planning: Answering High-Level Search Queries Using Human Computation

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# Human computation

“... address problems that computers can't yet tackle on their own and eventually teach computers many of these human talents.”



- Luis von Ahn, '08

# Google


Google Search


I'm Feeling Lucky


# Relevant information

human computation  

About 13,300,000 results (0.15 seconds) [Advanced search](#)

▶ [Human-based computation - Wikipedia, the free encyclopedia](#)   
[en.wikipedia.org/wiki/Human-based\\_computation](http://en.wikipedia.org/wiki/Human-based_computation) - [Cached](#)  
**Human-based computation** is a computer science technique in which a **computational** process performs its function by outsourcing certain steps to humans. ...  
[Early work - Classes of human-based computation](#)

[Luis von Ahn's Research](#)   
[www.cs.cmu.edu/~biglou/research.html](http://www.cs.cmu.edu/~biglou/research.html) - [Cached](#)  
**Human Computation.** Most of my time is spent inventing novel techniques for utilizing the computational abilities (or "cycles") of humans. ...

[The 3rd Human Computation Workshop \(HCOMP 2011\)](#)   
[www.humancomputation.com/](http://www.humancomputation.com/) - [Cached](#)  
**Human Computation** is the study of systems where humans perform a major part of the computation or are an integral part of the overall computational system. ...

# People use search not just to find information, but to **solve problems**

I want to manage  
my inbox better

I need to plan a first date with  
a girl I met in yoga class

I want to make an awesome  
wedding present

# Search scenario today

- User has a high-level mission in mind  
*e.g., I need to plan a one-week vacation in Paris*
- User identifies important sub-problems  
*e.g., find restaurants, understand the metro, etc.*
- User enters multiple queries to find web resources relevant to sub-problems  
*e.g., lunch near Notre Dame, bistros in Paris, etc.*

Search scenario today

User has to do all the planning!

# Next-generation search engine

User enters a high-level **mission**

System generates a **plan** to achieve mission

## Simple plan

- Steps to take
- Why a step is important
- Resources for each step

## Complex plan

- Conditional branches
- Recourse decisions  
(if a step fails, do this)



# Example

I want to live a more healthy life

Stop smoking

Eat healthier food

Learn to cook at home

Exercise

Follow a diet plan

Drink less alcohol

Spend time with friends

Sleep well

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**running tips**

<http://www.runnersworld.com/>

**best bike routes**

<http://www.roadbikejourney.com/>

**personal trainer**

<http://www.fitsf.com>

# Huge gap

- Understand natural language missions
- Know how to solve everyday problems

# CrowdPlan

User enters a high-level **mission**

CrowdPlan recruits a crowd to decompose the mission into **actionable steps** and formulate **queries**

CrowdPlan generates a **simple plan** containing a set of steps and web resources for each step

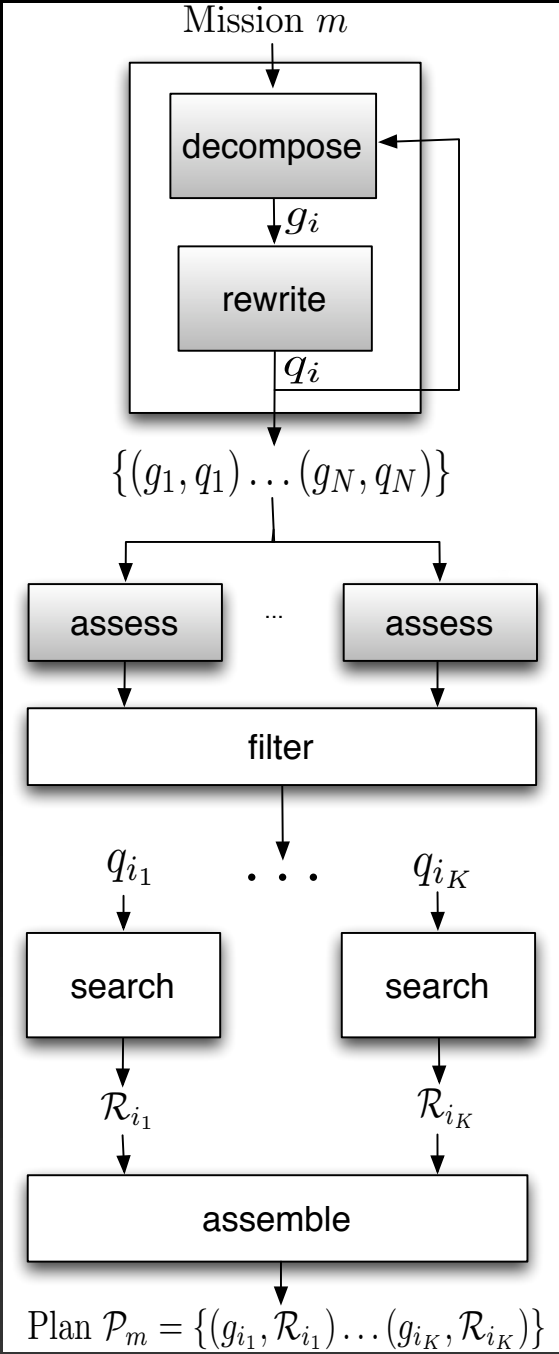
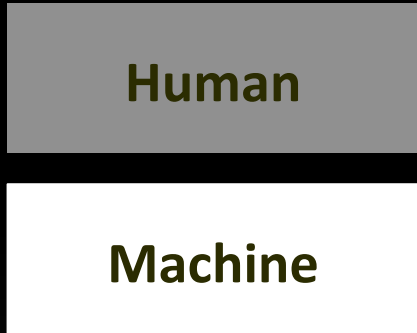
# This talk

- How CrowdPlan works
- User studies
- Collaborative planning

# Related work in web search

- **User intent** [BCG06, LLC05, RL04, JK08, ...]
  - Prediction models require intent-to-query mappings that are difficult to obtain
  - CrowdPlan addresses user mission directly, and thus produce such mappings as a by-product
- **Diversification** [SMO10, CKCVABM08, CK06, ...]
  - CrowdPlan identifies **actionable steps** for solving a problem, and not just aspects related to the query

# CrowdPlan



# decompose + rewrite

## Help someone to cook at home more often

Previous turkers have suggested some steps for helping someone to **cook at home more often**:

- Fill your pantry with food staples.
- invest in good cookware
- Find quick and easy recipes to make.
- Make larger amounts when you cook, then freeze the extra for days you have less time.

(a) Suggest **another step** that would help someone to **cook at home more often**. The step you specify must start with a verb, e.g., if the goal is to "throw a New Year's party," a possible step might be "make invitations."

(b) Suggest a **search query** (something you would type into google) for finding web resources that help with the step you specified in (a):

(c) Briefly **explain why** the step and search query you suggested help to accomplish the goal:



# assess, filter

## Help someone to cook at home more often

Please select **poor search queries** (if any) that are unlikely to return good search results that take steps toward helping someone to **cook at home more often**.

**Tip:** keep the goal in mind as you look through the search queries. Search queries do not have to be worded like the goal to be helpful, and search queries that appear reasonable could nevertheless lead to poor search results! If you are *ever* in doubt, click on a query to see search results from google (it will open in a new window, so no worries about losing the HIT).

- [healthy food](#)
- [Kitchenaid](#)
- [Quick and easy recipes](#)
- [cooking veg and non veg recipe](#)
- [plan a menu](#)
- [learning to cook book](#)
- [Foods that freeze well](#)
- [savings accounts](#)
- [best cooking shows](#)
- [Easy cookwares](#)

# search, assemble

## Your goal is to cook at home more often.

---

- + Fill your pantry with food staples.
- + invest in good cookware
- + Find quick and easy recipes to make.
- + decide vegetarian or non vegetarian recipe
- Decide what you want to eat and plan a menu for the week.

Search:

### Search results for "plan a menu"

#### [A Basic Guide to Menu Planning — Simple Mom](#)

Jul 7, 2008 ... Thanks for visiting Simple Mom. If you subscribe to the blog via RSS feed or via email, you'll get helpful tips and encouragement for ...  
[simplemom.net/how-to-menu-plan/](http://simplemom.net/how-to-menu-plan/)

#### [Menu Plan Monday : I'm an Organizing Junkie](#)

Jul 31, 2006 ... As promised here is my menu plan for this week. Please keep in mind that I like to keep things simple yet healthy if I can. ...  
[orgjunkie.com/2006/07/menu-plan-monday.html](http://orgjunkie.com/2006/07/menu-plan-monday.html)

# User studies

- 14 subjects, mostly non-CS college grads
- Two missions
  - a new year resolution or life goal
  - a concrete task they want to accomplish
- Conditions
  - Rewriting missions vs. missions as queries directly
  - CrowdPlan vs. rewriting mission statements
  - simple plans interface vs. standard

## Your new year's resolution is to manage your inbox better.

---

- + Delete old unimportant emails.
- + Use spam filters
- + create sorting folders
- + Add an inbox assistant application
- + create a priority list of accepted emails
- + move to trash and folders
- organizing the mails in to categories. Example company, friends, personal.

Search:

go

### Search results for "organise inbox better"

#### [Organize your Inbox: 7 ways to order and sort your email](#)

Organize your email: Keep your Inbox in order with these seven tips to help you better sort, store, and search in Outlook.

[www.microsoft.com/atwork/productivity/emailtools.aspx](http://www.microsoft.com/atwork/productivity/emailtools.aspx)

#### [Organize Your Gmail Inbox Better With ActiveInbox](#)

Nov 27, 2010 ... We send and receive lots of emails daily. Many of the messages we receive are important ones requiring some further action or reply - but ...

[www.makeuseof.com/tag/organize-gmail-inbox-activeinbox/](http://www.makeuseof.com/tag/organize-gmail-inbox-activeinbox/)

## Your concrete task is to finish the bathroom and laundry room in our basement.

---

- + Find a contractor
- + Go to home depot to ask what materials you need.
- + Develop a budget so you know how much money you have available to spend for your project.
- + plan properly
- + search magazines and the internet for design ideas
- + Find used appliances or fixtures.
- + Consult engineer about the plan
- + go to this site - [http://www.rona.ca/content/renovate-bathroom\\_projects](http://www.rona.ca/content/renovate-bathroom_projects)
- + search best ways to build rooms
- make a blueprint

Search:

### Search results for "blueprint for bathroom"

#### [iBaths.com - Master Baths](#)

This blueprint features many common traits of a master bathroom. See 3-D renderings of the blueprint: [/assets/0/840/900/906/918/e689f0c9-b078 ...](#)  
[ibaths.com/design/types-layouts/master-baths.aspx](http://ibaths.com/design/types-layouts/master-baths.aspx)

#### [Bathroom Remodeling](#)

We are also happy to take design a bathroom blueprint for you that would consist of only Wasauna products, or a mix of Wasauna products and products from ...  
[www.wasauna.com/bathroom-remodeling.html](http://www.wasauna.com/bathroom-remodeling.html)

Those who prefer CrowdPlan's search results note that they are more **diverse** and **actionable**

Those who prefer standard search results note that they are more **relevant** and **authoritative**

“The standard search tool was better because I **knew enough about what I wanted** that I could type in more specific searches.”

“I think many good websites will give me a one-stop shop for marathon information. The simple plan was fairly comprehensive although perhaps too specific.”

“ The simple plan solves to some degree the problem of unknown unknown, which is that in order to find something you need to know you need it. This problem makes the standard interface of limited use, because you need to know a priori what you have to do in order to find instructions on how to do it. But the simple plan, being broader in its results, suggests things you didn't think of.”



“The simple plan actually organized my search for me, into discrete and **doable steps**. The standard search tool left me to do all the creative parsing and generation of search terms. I felt that the simple plan gave me a **roadmap** to the entire space by my mentioning something in that space.”

Simple plans are effective for

- **identifying steps** that a user may have missed
- providing an organized **roadmap**
- suggesting concrete, **actionable** steps

# Collaborative Planning

- Harness the crowd to come up with plans for solving problems
- Plans can be **personal** and **complex**

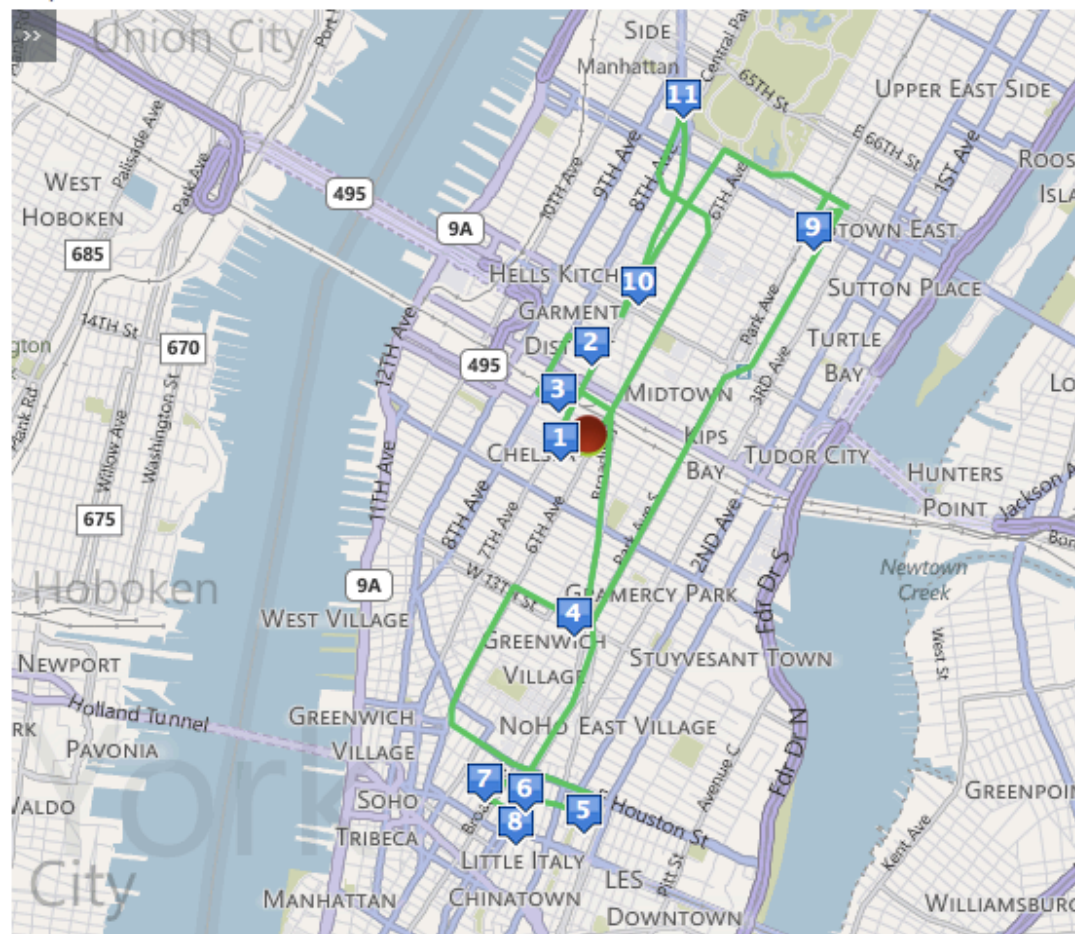
# Mobi: crowd plans your vacation

I am taking my teenage daughter to NYC in a few weeks for a mother and daughter getaway. We are looking for places to shop and visit -- my daughter loves fashion and design, so suggestions along those lines are most helpful. We are not big on the touristy places, but instead, finding amazing dessert is a must! :) I have also always wanted to see a Broadway show, so suggestions for shows to see would be helpful. Thanks so much!

In planning our trip, please pay attention to our wishes below:

- have exactly 1 simple lunch (not fast-food) activity.
- have exactly 1 italian for dinner activity.
- have exactly 1 broadway shows activity.
- have at least 2 amazing desserts activities.
- spend at least 3 hours on fashion or design.

Trip time: 13 hours and 10 minutes



- arrive at Eventi Hotel (10:00am)
- 1 Visit The Museum at FIT (10:04am–10:49am)
- 2 Visit to Mood (10:59am–11:29am)
- 3 Madison Square Garden (11:38am–12:08pm)
- 4 Chocolate to the Max (12:21pm–12:41pm)
- 5 Sara D Roosevelt Park (12:56pm–1:11pm)
- 6 Lunch at Soho Park (1:17pm–2:02pm)
- 7 Shop the boutiques of Soho (2:06pm–3:21pm)
- 8 Cheesecake at Eileen's (3:27pm–4:27pm)
- 9 Tour the fashion flagship stores of 5th Ave. (4:46pm–6:31pm)
- 10 Carmine's Dinner (6:47pm–7:47pm)
- 11 Wonderland (7:57pm–10:57pm)
- arrive at Eventi Hotel (11:10pm)

# Conclusion

- **CrowdPlan** tackles high-level search queries directly by harnessing a crowd to decompose missions into concrete, actionable steps and by gathering web resources that help with each step
- **Collaborative Planning** opens up new opportunities for complementing human and machine intelligence.

# Thank you

I want to provide feedback

Ask a question right now

Find Haoqi and Edith at AAI

Read the paper

Email [hq@eecs.harvard.edu](mailto:hq@eecs.harvard.edu) and [edith@cmu.edu](mailto:edith@cmu.edu)