

Exploring the Responses of Large Language Models to Beginner Programmers' Help Requests

Arto Hellas
Aalto University
Finland
arto.hellas@aalto.fi

Charles Koutcheme
Aalto University
Finland
charles.koutcheme@aalto.fi

Juho Leinonen
The University of Auckland
New Zealand
juho.leinonen@auckland.ac.nz

Lilja Kujanpää
Aalto University
Finland
lilja.kujanpaa@aalto.fi

Sami Sarsa
Aalto University
Finland
sami.sarsa@aalto.fi

Juha Sorva
Aalto University
Finland
juha.sorva@aalto.fi

ABSTRACT

Background and Context: Over the past year, large language models (LLMs) have taken the world by storm. In computing education, like in other walks of life, many opportunities and threats have emerged as a consequence.

Objectives: In this article, we explore such opportunities and threats in a specific area: responding to student programmers' help requests. More specifically, we assess how good LLMs are at identifying issues in problematic code that students request help on.

Method: We collected a sample of help requests and code from an online programming course. We then prompted two different LLMs (OpenAI Codex and GPT-3.5) to identify and explain the issues in the students' code and assessed the LLM-generated answers both quantitatively and qualitatively.

Findings: GPT-3.5 outperforms Codex in most respects. Both LLMs frequently find at least one actual issue in each student program (GPT-3.5 in 90% of the cases). Neither LLM excels at finding all the issues (GPT-3.5 finding them 57% of the time). False positives are common (40% chance for GPT-3.5). The advice that the LLMs provide on the issues is often sensible. The LLMs perform better on issues involving program logic rather than on output formatting. Model solutions are frequently provided even when the LLM is prompted not to. LLM responses to prompts in a non-English language are only slightly worse than responses to English prompts.

Implications: Our results continue to highlight the utility of LLMs in programming education. At the same time, the results highlight the unreliability of LLMs: LLMs make some of the same mistakes that students do, perhaps especially when formatting output as required by automated assessment systems. Our study informs teachers interested in using LLMs as well as future efforts to customize LLMs for the needs of programming education.

CCS CONCEPTS

• Social and professional topics → Computing education; • Computing methodologies → Natural language generation.

KEYWORDS

large language models, introductory programming education, CS1, help seeking, student questions, automatic feedback, OpenAI Codex, GPT

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1 INTRODUCTION

Within the last year, large language models (LLMs) and tools built on them, such as ChatGPT and GitHub Copilot, have broken into the mainstream. Computing education research (CER), too, has seen an explosion of recent work exploring the opportunities and challenges that LLMs bring. Opportunities in computing education include the automation of natural-language explanations of code [43, 54, 53, 76], personalized exercises [18, 76], enhanced error messages [43], and assistance in solving CS1 exercises [89]. Challenges include student over-reliance and plagiarism [6, 16, 22, 71] as well as biases in generated content [6, 59].

For better or worse, vast numbers of students are already using LLMs to assist them in their studies. Such use is likely only to increase in the future. Some student use of LLMs will happen unofficially at each student's discretion and will employ highly generic tools akin to ChatGPT¹ or programming-generic tools such as Codex². The future may also see custom LLMs that have been designed to assist students of programming and that teachers adopt as official components of programming courses.

One potential application of LLMs is to respond to students' help requests. In an ideal world, an LLM might assist a programming student who asks for help in many of the same ways that a

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¹<https://openai.com/blog/chatgpt>

²<https://openai.com/blog/openai-codex>

Help System Authors And Programmers Guide

J. Stephen Pendergrast



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Netscape Developer's Guide to Plug-ins Douglas A. Young,1997 The first book in a series that focuses on Netscape for developers this book provides an overview of Netscape as a development environment It compares and contrasts various technologies and describes how to write Netscape plugins program code that enables applications to be launched from Netscape desktop The CD contains code examples and reusable plugins **The Computer Based Training Handbook** William W. Lee,Robert A. Mamone,1995 **Scientific and Technical Aerospace Reports** ,1990 **The IBM PC AT Programmer's Guide** James T. Smith,1986 Clearly presents what you need to know to take complete control of the PC AT Provides extensive information about DOS 3.0 the Intel 80286 and the PC AT BIOS to give you all the tools you need for proficient programming Also included is a detailed background on the IBM family of personal computers how they differ from the AT and the Intel 8086 CPU family **PC Mag** ,1991-04-30 PCMag.com is a leading authority on technology delivering Labs based independent reviews of the latest products and services Our expert industry analysis and practical solutions help you make better buying decisions and get more from technology *MacTech Magazine* ,1996 Bibliography of Scientific and Industrial Reports ,1965-07 **The British National Bibliography** Arthur James Wells,2002 Windows 98 Programming from the Ground Up Herbert Schildt,1998 Comprehensive self paced guide filled with new options and new features **Oracle PL/SQL Programming** Steven Feuerstein,1995 Oracle is the most popular database management system in use today and PL SQL plays a pivotal role in current and projected Oracle products and applications This book fills a huge gap in the ORACLE market by providing developers with a single comprehensive guide to building applications with PL SQL Includes strategies code architectures tips techniques and fully realized code *U.S. Government Research & Development Reports* ,1967 **Dr. Dobb's Journal** ,2004 **Dr. Dobb's Journal for Users of Small Computer Systems** ,1984 **Windows/DOS Developer's Journal** ,1995 **Government Reports Announcements** ,1973-08-10

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