Planificación en Entornos con Incertidumbre

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*Resumen* — Este documento recopila el proceso, la implementación y las experiencias de los autores del mismo tras realizar el trabajo propuesto llamado “Planificación en Entornos con Incertidumbre” por el profesor Ignacio Pérez Hurtado de Mendoza para la asignatura Inteligencia Artificial.

# Introducción

Nuestro objetivo trata sobre realizar una implementación en Python que permita resolver y mostrar los resultados de un problema planteado como POMDP mediante uno de los dos algoritmos, bien sea POMCP (*Partially Observable Monte-Carlo Planning*) o PBVI (Point-Based Value Iteration) y mostrar sus resultados de dos formas distintas: (1) Simulación interactiva, (2) Simulación silenciosa o *benchmark*. Para ello, hemos utilizado y modificado una librería que nos permitirá ejecutar simulaciones dado un problema en formato “POMDP” llamada “PyPOMDP” [1] con el fin de obtener y mostrar los resultados de ambas formas requeridas.

# Preliminares

## Compresión del enunciado y análisis

Antes de realizar la implementación, nos reunimos para analizar el enunciado del trabajo y poder comprender aquello que nos pedían además de los requisitos de la entrega y los criterios de evaluación. Para ello, primero hicimos un análisis sobre los Procesos de Decisión de Markov para después enfocarnos en los Procesos de Decisión de Markov Parcialmente Observables (POMDP).

Tras analizarlo, llegamos a la conclusión de que, en resumen, los POMDP son extensiones de los MDPs, pero no se conoce el estado actual. Para ello planificador debe representar su creencia o *belief* a través de una distribución de probabilidad sobre el conjunto de estados. Cada vez que realizamos una acción, se desconoce el estado concreto que se alcanza, pero se obtiene una observación que permite actualizar el *belief*. Además, posee una serie de elementos entre los que se encuentran:

### S. Representa el conjunto de estados

### A. Representa el conjunto de acciones

### T. Es la funcion de transición

* *R.* Es la recompensa obtenida
* *Z.* Representa el conjunto de observaciones
* *O.* Es la función de observación

## Instalación del entorno de desarrollo

Antes de realizar la implementación, tuvimos que descargar e instalar el software en nuestros respectivos equipos para poder llevarla a cabo. Para ello, decidimos utilizar el entorno llamado “PyCharm” [2] y debido a que íbamos a trabajar sobre sistemas operativos Windows y habíamos trabajado antes con entornos similares era nuestra mejor opción.

## Importación de la librería

Una vez instalado el entorno de desarrollo, accedimos y analizamos la librería “PyPOMDP” [1] con el fin de ver si realmente nos era útil para realizar la implementación. Para ello, el autor del documento Luis Candelario realizó un “*fork*” del repositorio con el fin de poder trabajar directamente con él. Tras esto, decidimos importar la librería en nuestro entorno de desarrollo y comenzar a implementar no sin antes, consultar el fichero “Readme.md” para instalar los paquetes de Python necesarios, así como probar el ejemplo de instrucción para un problema ya implementado en la librería con uno de los algoritmos deseados para ver si realmente funcionaba. En este caso fue el problema del Tigre de 3 puertas “Tiger-3D.POMP” con el algoritmo POMCP y para ello ejecutamos la instrucción:

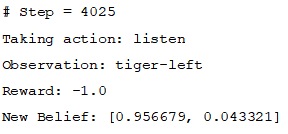
> python main.py pomcp --env Tiger-3D.POMDP

La prueba fue exitosa y comenzó a mostrar los resultados en la consola.

# Metodología

Una vez probado el problema del Tigre de 3 puertas, nos percatamos de que también estaba implementado el problema del tigre de 2 puertas, sin embargo, este no funcionaba. Para ello, corregimos el formato del documento “Tiger-2D.POMP” y ejecutamos la instrucción principal de nuevo mostrando los resultados en la consola.

En estos resultados apreciamos que la salida que aparece a continuación se mostraba un número determinado de veces sin parar, dado por el valor por defecto (100) del argumento “max\_play” de la clase “main.py”.



Fue en este momento cuando nos percatamos de que el algoritmo empleado no

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## Units

* Use either SI (MKS) or CGS as primary units. (SI units are encouraged.) English units may be used as secondary units (in parentheses). An exception would be the use of English units as identifiers in trade, such as “3.5-inch disk drive”.
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Identify applicable funding agency here. If none, delete this text box.

* Use a zero before decimal points: “0.25”, not “.25”. Use “cm3”, not “cc”. (*bullet list*)

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*a**b* 

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## Some Common Mistakes

* The word “data” is plural, not singular.
* The subscript for the permeability of vacuum **0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter “o”.
* In American English, commas, semicolons, periods, question and exclamation marks are located within quotation marks only when a complete thought or name is cited, such as a title or full quotation. When quotation marks are used, instead of a bold or italic typeface, to highlight a word or phrase, punctuation should appear outside of the quotation marks. A parenthetical phrase or statement at the end of a sentence is punctuated outside of the closing parenthesis (like this). (A parenthetical sentence is punctuated within the parentheses.)
* A graph within a graph is an “inset”, not an “insert”. The word alternatively is preferred to the word “alternately” (unless you really mean something that alternates).
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* In your paper title, if the words “that uses” can accurately replace the word “using”, capitalize the “u”; if not, keep using lower-cased.
* Be aware of the different meanings of the homophones “affect” and “effect”, “complement” and “compliment”, “discreet” and “discrete”, “principal” and “principle”.
* Do not confuse “imply” and “infer”.
* The prefix “non” is not a word; it should be joined to the word it modifies, usually without a hyphen.
* There is no period after the “et” in the Latin abbreviation “et al.”.
* The abbreviation “i.e.” means “that is”, and the abbreviation “e.g.” means “for example”.

An excellent style manual for science writers is [7].

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1. Table Type Styles

| Table Head | Table Column Head | | |
| --- | --- | --- | --- |
| Table column subhead | Subhead | Subhead |
| copy | More table copya |  |  |

1. Sample of a Table footnote. (*Table footnote*)
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##### Acknowledgment *(Heading 5)*

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1. Di, Lu. Data science software engineer at the University of Sydney. (https://github.com/namoshizun/PyPOMDP)
2. Pycharm, Jet Brains (https://www.jetbrains.com/pycharm)
3. K. Elissa, “Title of paper if known,” unpublished.
4. R. Nicole, “Title of paper with only first word capitalized,” J. Name Stand. Abbrev., in press.
5. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, “Electron spectroscopy studies on magneto-optical media and plastic substrate interface,” IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982].
6. M. Young, The Technical Writer’s Handbook. Mill Valley, CA: University Science, 1989.

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