Using human-like creative computing (AI) to assist in geological interpretation

This PhD aims to create a new AI-based system for interpretation of the rock record, based on the concept of human-like learning, which can rapidly create a wide range of plausible geological interpretations that fit observations and explain their logical basis. The PhD will make use of novel technology based on concept invention that has been applied to a wide range of problems such as mathematical proofs, music composition and painting (http://www.thepaintingfool.com). These techniques are novel in that they build upon pre-existing knowledge, encapsulated as a set of rules or heuristics, from which the system can create a wide ranging set of new concepts that fit any observations. In short they invent ideas that don't violate any pre-existing knowledge/rules we might have.

This breadth of interpretation is of particular interest to geologists as often there is limited information available about the subsurface, thus a wide range of concepts of the geology must be explored to adequately cover uncertainty. Bond et al (2008) demonstrated this need by showing how many different interpretations of the same seismic line can be produced by different geoscientists, due differences in their background/experience, suggesting the ideal (but impractical) solution is for many interpreters to work on the same problem.

The key benefit of the approaches used in this PhD are their ability to automatically generate plausible interpretations of the geology **and** explain their logical basis (what it is and why) without the need to encode a complete set of geological rules/relationships. These approaches act like a human geologist in that it can tell you what something is and why it came to that answer. This ability is essential in order for the results of any computer based interpretation to be useful to the geological community and not act as a "black box". Technology developed in this PhD will be able to investigate a large number of possible interpretations and could present back to the user (geologist) the logic behind each possibility as, for instance, a set of geological rules/events in a specific order that create an outcome that fits the observations.

The candidate will work with geologists at Heriot-Watt and AI experts at Dundee university to develop unique knowledge of these novel AI tools, while applying them to the geological context. This represents a unique opportunity to learn about innovative AI techniques for any applicant.

Initially the task will be to work on simple geological problems taken from outcrops, ideally building up to a system that can tackle the full complexity of a real oil field. The aim is to build a code framework that is robust enough to be adapted to work on a range of subsurface problems including oil and gas reservoirs, geothermal systems and energy storage sites and can interpret a range of geological scenarios based on available data and observations.

Candidates can either be numerate geoscientists or computer scientists who would like to develop a career in applying the latest AI techniques to subsurface related industries.