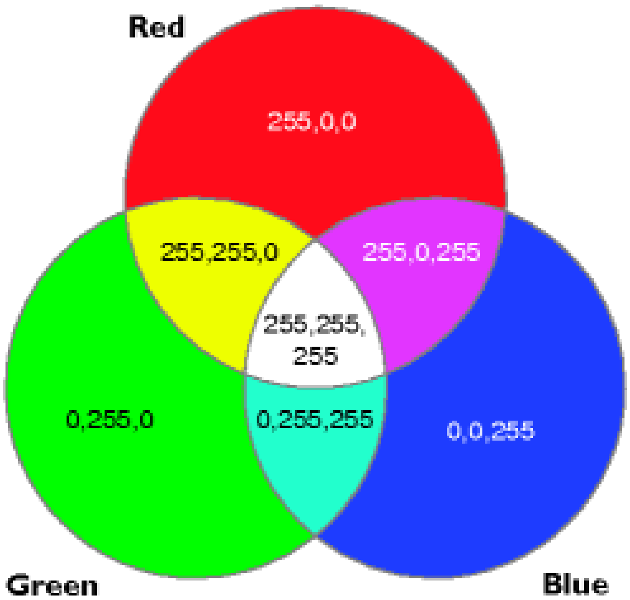
IMAGE PROCESSING
3.1 COLOUR RELATED DESCRIPTIONS
3.1.1 RGB COLOUR MODELS

A colour model is an abstract mathematical model describing the way colours can be represented as tuples of numbers; typically as three or four values or colour components .when this model is associated with a precise description of how the components are to be intercepted(viewing condition ,etc),the resulting set of colours is called colour space .

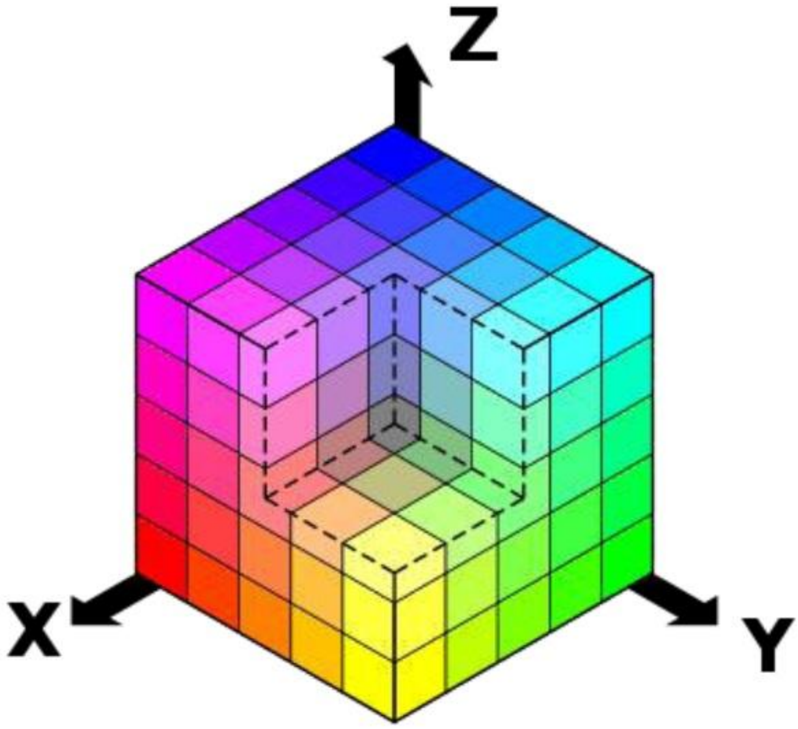
The RGB colour model or RGB colour standard (often spelled RGB in historical engineering literature) in an additive model in which red, green, and blue (often used in additive light models) are combined in various ways to reproduce other colours .the name of the model and the abbreviation RGB come from three primary colours ,red, green ,and blue and the technology development of cathode ray tubes which could display colour instead of a monochrome phosphorescence (including grey scaling) such as black and white film and television imaging. The term RGBA is also used to mean Red, Green, Blue, and Alpha. This is not a different colour models, but a representation; the Alpha is used for transparency.

These three colours should not be confused with the primary pigments of red, blue, and yellow, known in the art world as ‘primary colours‘, as the latter combine based on reflection and absorption of photons whereas RGB depends on emission of photons from a compound excited to a higher energy state by impact with an electron beam. The RGB colour model itself does not define what is meant by ‘red’, ‘blue’ and ‘green‘, (spectroscopic), and so the results of mixing them are not specified as exact (but relative, and averaged by the human eye)



When the exact spectral make-up of the red, green and blue primaries are defined, the colour model would then become what is known in science and engineering as an absolute colour space, such as RGB or Adobe RGB.

A representation of additive colour mixing-In CRT based (analog electronics) television three colour electron guns are used to stimulate such an arrangement of phosphorescent coatings of the glass, the resultant reemission of photons providing the image seen by the eye. The RGB colour model mapped to a cube (with cut-away shown).



NUMERIC REPRESENTATIONS

A colour in the RGB colour model can be described by indicating how much of each of the red, green and blue colour is included. Each can vary between the minimum (no colour) and maximum (full intensity). If all the colours are at minimum, the result is black. If all the colours are at maximum, the result is white. A confusing aspect of the RGB colour model is that these colours may be written in several different ways.

* Colour science talks about colours in the range 0.0 (minimum) to 1.0 (maximum). Most colour formulae take these values. For instance, full intensity red is 1.0, and 0.0.

* The colour values may be written as percentages, from 0 %(minimum) to 100 %(maximum). To convert from the range 0.0 to 1.0, see percentage. Full intensity red is 100%, 0%.

* The colour values may be written as numbers in the range 0 to 255, simply by multiplying the range 0.0 to 0.1 by 255. This is commonly found in computer science, where programmers have found it convenient to store each colour value in one 8-bit byte. This convention has become so widespread that many writers now consider the range 0 to 255 authoritative and do not give a context for their values. Full intensity red is 255, 0.

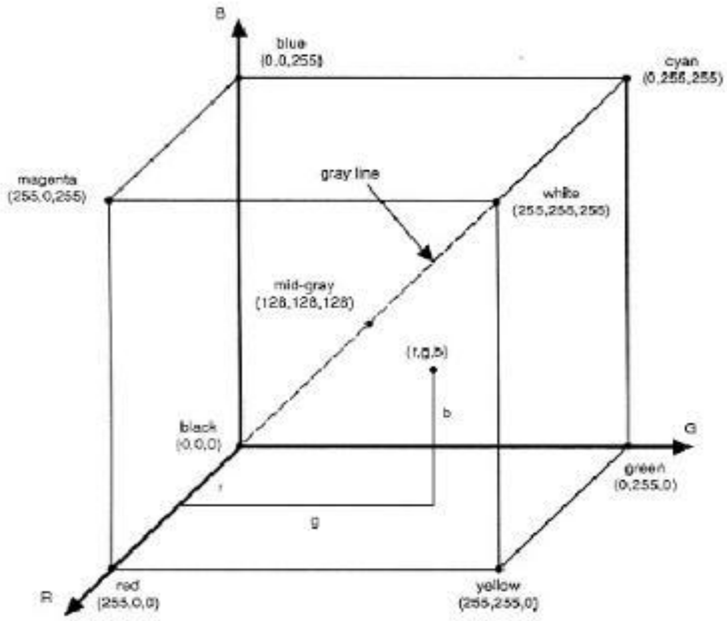
*The same range, 0 to 255, is sometimes written in hexadecimal, sometimes with a prefix (e.g. #). Because hexadecimal numbers in this range can be written with a fixed two digit format, the full intensity red #ff, #00, #00 might be contracted to #ff0000. This convention is used in web colours and is also considered by some writers to be authoritative.

24 BIT REPRESENTATION

When written, RGB values in 24 bits per pixel(bpp),also known as true colour, are commonly specified using 3 integers between 0 and 255, each representing red, green and blue intensities, in that order. For example:

The above definition uses a convention known as full range RGB. This convention is so often used that some people have come to view it as universal. This can be confusing because colour values are also often considered to be in the range 0.0 through 1.0,rather then 0 to 255(the latter range is used when colours are encoded in eight bits, which encoding permits 256 different values(sometimes written using two hexadecimal characters)). If in doubt, it is best to describe the range over which a colour specified.

Full range RGB can represent up to 255 shades of a given hue. (Only pure reds, greens or gray have this full range of shades.) Typically, RGB for digital video is not full rage. Instead, video RGB uses a convention with scaling and offsets such that (16, 16, 16) is black,(235,235,235) is white, etc. for example, these scaling and offsets are used for the digital RGB definition in CCIR 601.



CONVERSION OF AN IMAGE FROM RGB TO GRAY-SCALE

Start with the first pixel.
Calculate r=30% of RED Component;
g=59% of GREEN Component;
b=11% of BLUE Component;
Add and normalize.(Divide by 3)

CANNY OPERATOR FOR EDGE DETECTION

Canny Filter for edge detection consists of following pair impulse response:

$$G(x) = \exp 0.5 \left(\frac{x}{\sigma}\right)^2$$

$$F(x) = -\left(\frac{x}{\sigma^2}\right) \exp -0.5 \left(\frac{x}{\sigma}\right)^2$$

The input image is convolved with by G(x) and then F(x) in the horizontal and vertical directions respectively to get the gradient image I_x and I_y. Next, the magnitude of gradient image $I_m=(I_x^2 + I_y^2)$ is computed. Edges are detected after non-maxima suppression, evaluation of noise by histogram and threshold using Hysteresis, where a pixel representing an edge takes a value of 1 and a non edge pixel takes 0. So the output image will be of logical type.

Canny's aim was to discover the optimal edge detection algorithm. In this situation, an "optimal" edge detector means:

**good detection* – the algorithm should mark as many real edges in the image as possible.

**good localization* – edges marked should be as close as possible to the edge in the real image.

**minimal response* – a given edge in the image should only be marked once, and where possible, image noise should not create false edges.

To satisfy these requirements Canny used the calculus of variations – a technique which finds the function which optimizes a given functional. The optimal function in Canny's detector is described by the sum of four exponential terms, but can be approximated by the first derivative of a Gaussian.

STAGES OF CANNY EDGE DETECTION FILTER:

(1) NOISE REDUCTION

The Canny edge detector uses a filter based on the first derivative of a Gaussian, because it is susceptible to noise present on raw unprocessed image data, so to begin with, the raw image is convolved with a Gaussian filter. The result is a slightly blurred version of the original which is not affected by a single noisy pixel to any significant degree.

Here is an example of a 5x5 Gaussian filter, used to create the image to the right, with σ = 1.4:

$$\mathbf{B} = \frac{1}{159}\begin{bmatrix} 2 & 4 & 5 & 4 & 2 \\ 4 & 9 & 12 & 9 & 4 \\ 5 & 12 & 15 & 12 & 5 \\ 4 & 9 & 12 & 9 & 4 \\ 2 & 4 & 5 & 4 & 2 \end{bmatrix} * \mathbf{A}.$$

An edge in an image may point in a variety of directions, so the Canny algorithm uses four filters to detect horizontal, vertical and diagonal edges in the blurred image. The edge detection operator (Roberts, Prewitt, Sobel for example) returns a value for the first derivative in the horizontal direction (Gy) and the vertical direction (Gx). From this the edge gradient and direction can be determined:

$$\mathbf{G} = \sqrt{\mathbf{G}_x{}^2 + \mathbf{G}_y{}^2}$$
$$\mathbf{\Theta} = \arctan\left(\frac{\mathbf{G}_y}{\mathbf{G}_x}\right).$$

The edge direction angle is rounded to one of four angles representing vertical, horizontal and the two diagonals (0, 45, 90 and 135 degrees for example).

(2) NON-MAXIMUM SUPPRESSION

Given estimates of the image gradients, a search is then carried out to determine if the gradient magnitude assumes a local maximum in the gradient direction. So, for example,

*if the rounded gradient angle is zero degrees (i.e. the edge is in the north-south direction) the point will be considered to be on the edge if its intensity is greater than the intensities in the **west and east** directions,

*if the rounded gradient angle is 90 degrees (i.e. the edge is in the east-west direction) the point will be considered to be on the edge if its intensity is greater than the intensities in the **north and south** directions,

*if the rounded gradient angle is 135 degrees (i.e. the edge is in the north east-south west direction)the point will be considered to be on the edge if its intensity is greater than the intensities in the **north west and south east** directions,

*if the rounded gradient angle is 45 degrees (i.e. the edge is in the north west-south east direction)the point will be considered to be on the edge if its intensity is greater than the intensities in the **north east and south west** directions.

From this stage referred to as non-maximum suppression, a set of edge points, in the form of a binary image, is obtained. These are sometimes referred to as "thin edges".

(3) TRACING EDGES THROUGH THE IMAGE AND HYSTERESIS THRESHOLDING

Intensity gradients which are large are more likely to correspond to edges than if they are small. It is in most cases impossible to specify a threshold at which a given intensity gradient switches from corresponding to an edge into not doing so. Therefore Canny uses thresholding withhysteresis.

Thresholding with hysteresis requires two thresholds – high and low. Making the assumption that important edges should be along continuous curves in the image allows us to follow a faint section of a given line and to discard a few noisy pixels that do not constitute a line but have produced large gradients. Therefore we begin by applying a high threshold. This marks out the edges we can be fairly sure are genuine. Starting from these, using the directional information derived earlier, edges can be traced through the image. While tracing an edge, we apply the lower threshold, allowing us to trace faint sections of edges as long as we find a starting point.

Once this process is complete we have a binary image where each pixel is marked as either an edge pixel or a non-edge pixel. From complementary output from the edge tracing step, the binary edge map obtained in this way can also be treated as a set of edge curves, which after further processing can be represented as polygons in the image domain.

(4) DIFFERENTIAL GEOMETRIC FORMULATION OF THE CANNY EDGE DETECTOR

A more refined approach to obtain edges with sub-pixel accuracy is by using the approach of differential edge detection, where the requirement of non-maximum suppression is formulated in terms of second- and third-order derivatives computed from a scale-space representation (Lindeberg 1998) – see the article on edge detection for a detailed description.

(5) VARIATIONAL-GEOMETRIC FORMULATION OF THE HARALICK-CANNY EDGE DETECTOR

A variational explanation for the main ingredient of the Canny edge detector, that is, finding the zero crossings of the 2nd derivative along the gradient direction, was shown to be the result of minimizing a Kronrod-Minkowski functional while maximizing the integral over the alignment of the edge with the gradient field (Kimmel and Bruckstein 2003) see article on regularized Laplacian zero crossings and other optimal edge integrators for a detailed description.

PARAMETERS:

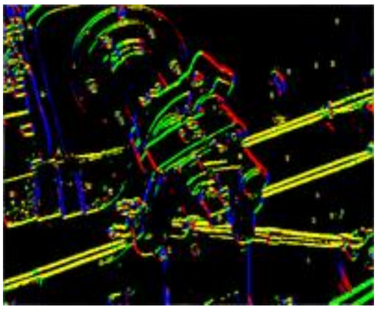
The Canny algorithm contains a number of adjustable parameters, which can affect the computation time and effectiveness of the algorithm.

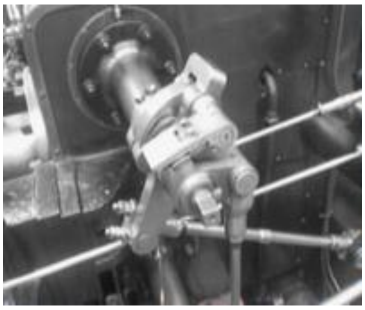
*The size of the Gaussian filter: the smoothing filter used in the first stage directly affects the results of the Canny algorithm. Smaller filters cause less blurring, and allow detection of small, sharp lines. A larger filter causes more blurring, smearing out the value of a given pixel over a larger area of the image. Larger blurring radii are more useful for detecting larger, smoother edges – for instance, the edge of a rainbow.

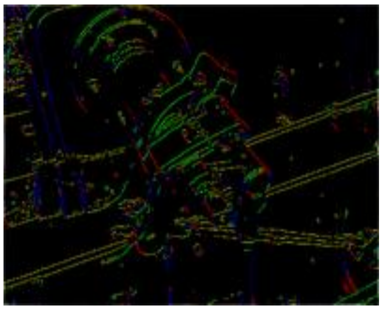
*Thresholds: the use of two thresholds with hysteresis allows more flexibility than in a single-threshold approach, but general problems of thresholding approaches still apply. A threshold set too high can miss important information. On the other hand, a threshold set too low will falsely identify irrelevant information (such as noise) as important. It is difficult to give a generic threshold that works well on all images. No tried and tested approach to this problem yet exists.

The Canny algorithm is adaptable to various environments. Its parameters allow it to be tailored to recognition of edges of differing characteristics depending on the particular requirements of a given implementation. In Canny's original paper, the derivation of the optimal filter led to a Finite Impulse Response filter, which can be slow to compute in the spatial domain if the amount of smoothing required is important (the filter will have a large spatial support in that case). For this reason, it is often suggested to use Rachid Deriche's infinite impulse response form of Canny's filter (the Canny-Deriche detector), which is recursive, and which can be computed in a short, fixed amount of time for any desired amount of smoothing. The second form is suitable for real time implementations in FPGAs orDSPs, or very fast embedded PCs. In this context, however, the regular recursive implementation of the Canny operator does not give a good approximation of rotational symmetry and therefore gives a bias towards horizontal and vertical edges.

VARIOUS STAGES OF CANNY EDGE FILTER WITH AN EXAMPLE







(A) (B) (C)

FIGURE(A): A binary edge map, derived from the Sobel operator, with a threshold of 80. The edges are coloured to indicate the edge direction: yellow for 90 degrees, green for 45 degrees, blue for 0 degrees and red for 135 degrees.

FIGURE(B): The image after a 5x5 Gaussian mask has been passed across each pixel.

FIGURE(C): The same binary map shown on the left after non-maxima suppression. The edges are still coloured to indicate direction.

HISTOGRAM OF AN IMAGE

An **image histogram** is a type of histogram that acts as a graphical representation of the tonal distribution in a digital image. It plots the number of pixels for each tonal value. By looking at the histogram for a specific image a viewer will be able to judge the entire tonal distribution at a glance.

Image histograms are present on many modern digital cameras. Photographers can use them as an aid to show the distribution of tones captured, and whether image detail has been lost to blown-out highlights or blacked-out shadows.

The horizontal axis of the graph represents the tonal variations, while the vertical axis represents the number of pixels in that particular tone.[1] The left side of the horizontal axis represents the black and dark areas, the middle represents medium grey and the right hand side represents light and pure white areas. The vertical axis represents the size of the area that is captured in each one of these zones. Thus, the histogram for a very bright image with few dark areas and/or shadows will have most of its data points on the right side and center of the graph. Conversely, the histogram for a very dark image will have the majority of its data points on the left side and center of the graph.

IMAGE MANIPULATION AND HISTOGRAMS

Image editors typically have provisions to create a histogram of the image being edited. The histogram plots the number of pixels in the image (vertical axis) with a particular brightness value (horizontal axis). Algorithms in the digital editor allow the user to visually adjust the brightness value of each pixel and to dynamically display the results as adjustments are made.[3] Improvements in picture brightness and contrast can thus be obtained.

In the field of computer vision, image histograms can be useful tools for thresholding. Because the information contained in the graph is a representation of pixel distribution as a function of tonal variation, image histograms can be analyzed for peaks and/or valleys which can then be used to determine a threshold value. This threshold value can then be used for edge detection, image segmentation, and co-occurrence matrices.

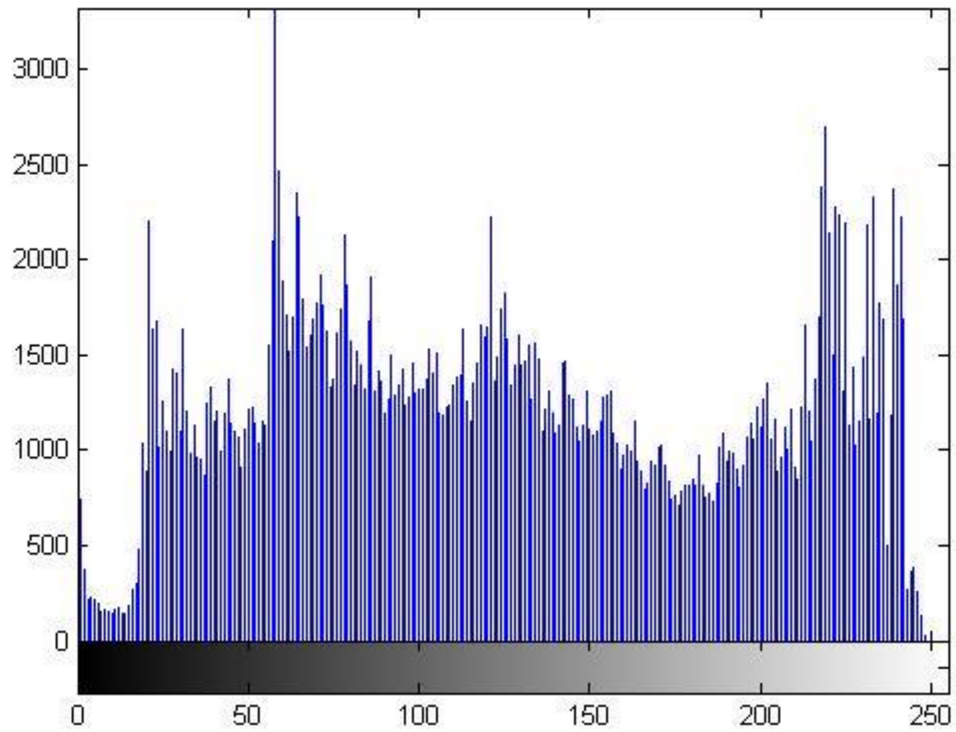


FIGURE: (A) (B) (C) EXAMPLE IMAGE, ITS GRAY VERSION AND HISTOGRAM

CHESS

Chess is a two-player board game played on a chessboard, a square checkered board with 64 squares arranged in an 8×8 grid. Each player begins the game with sixteen pieces: One king, one queen, two rooks, two knights, two bishops, and eight pawns. Pieces move in different ways according to their type, and accordingly are used to attack and capture the opponent's pieces. The object of the game is to checkmate the opponent's king by placing it under threat of capture ("check") which cannot be avoided. In addition to checkmate, the game can be won by the voluntary resignation of one's opponent, which may occur when too much material is lost, or if checkmate appears unavoidable. A game may result in a draw in several ways, and neither player wins.

Chess is one of the world's most popular games, played by millions of people worldwide at home, in clubs, online, by correspondence, and in tournaments. There are many chess variants that have different rules, different pieces, and different boards. In point of origin, in resemblance and in game theory chess is closely related to several Asian board games also played by millions, resulting in the game discussed by this article sometimes being termed "Western chess" or "International chess".

The play of the game is loosely divided into three phases, although the game may end decisively or as a draw in any phase. The beginning of a game of chess is called the opening, in which the purpose is the development of pieces – moving them from the fixed starting position to squares where they can be most effective. The openings are well studied, and opening theory in some lines of play has been worked out to twenty-five or thirty moves or more. Moves are chosen heuristically according to offensive and defensive considerations, or in response to immediate threats. The opening yields to the phase called the middlegame. Middlegame theory is the least extensively developed part of the game, but key principles include king safety (mating attacks), force (material), and mobility. In the endgame, few pieces remain on the board and the power of pawns to promote comes to the fore.

The official rules of chess are maintained by the World Chess Federation. Along with information on official chess tournaments, the rules are described in the FIDE Handbook, Laws of Chess section.

SETUP

Chess is played on a square boardof eight rows (called ranks and denoted with numbers 1 to 8) and eight columns (called files and denoted with letters a to h) of squares. The colors of the sixty-four squares alternate and are referred to as "light squares" and "dark squares". The chessboard is placed with a light square at the right-hand end of the rank nearest to each player, and the pieces are set out as shown in the diagram, with each queen on its own colour.

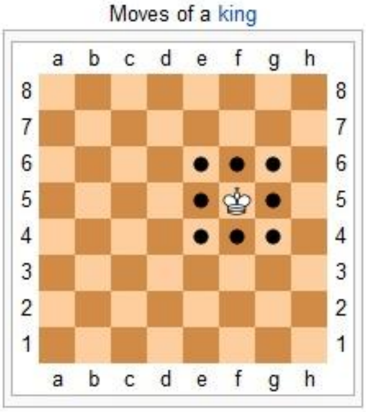
The pieces are divided, by convention, into white and black sets. The players are referred to as "White" and "Black" and each begins the game with sixteen pieces of the specified colour. These consist of one king, one queen, two rooks, two bishops, two knights, and eight pawns.

MOVEMENT

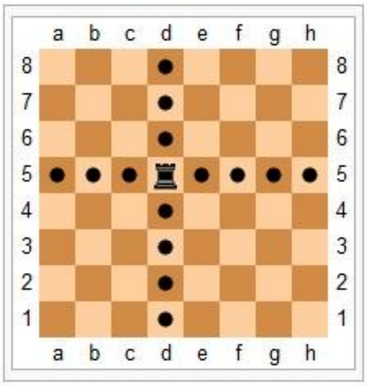
White always moves first. After the initial move, the players alternately move one piece at a time (with the exception of castling, when two pieces are moved). Pieces are moved to either an unoccupied square or one occupied by an opponent's piece, which is captured and removed from play. With the sole exception of en passant, all pieces capture opponent's pieces by moving to the square that the opponent's piece occupies. A player may not make any move that would put or leave his king under attack. If the player to move has no legal moves, the game is over; it is either a checkmate—if the king is under attack—or a stalemate—if the king is not.

Each chess piece has its own style of moving. In the diagrams, the dots mark the squares where the piece can move if no other pieces (including one's own piece) are on the squares between the piece's initial position and its destination.

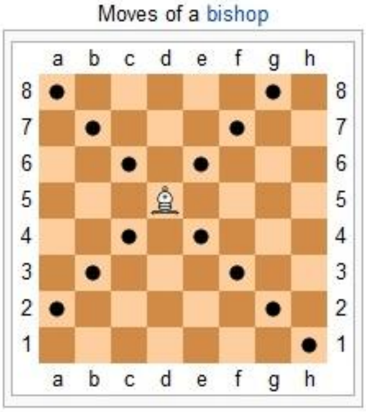
Moves of a king



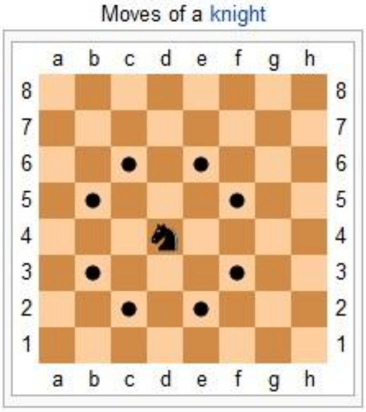
Moves of a rook



Moves of a bishop

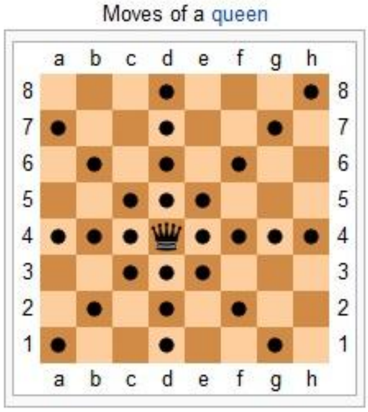


Moves of a knight

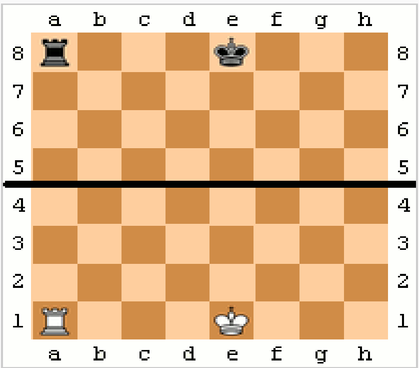


Moves of a pawn

Moves of a queen

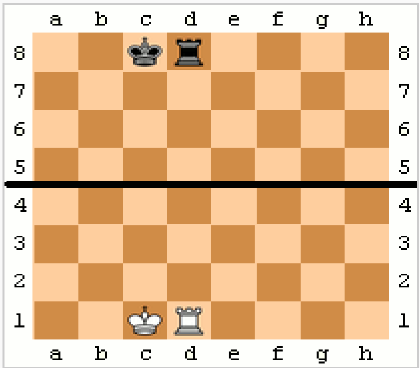


- The king moves one square in any direction. The king has also a special move which is called castling and involves also moving a rook.
- The rook can move any number of squares along any rank or file, but may not leap over other pieces. Along with the king, the rook is involved during the king's castling move.
- The bishop can move any number of squares diagonally, but may not leap over other pieces.
- The queen combines the power of the rook and bishop and can move any number of squares along rank, file, or diagonal, but it may not leap over other pieces.
- The knight moves to any of the closest squares that are not on the same rank, file, or diagonal, thus the move forms an "L"-shape two squares long and one square wide. The knight is the only piece that can leap over other pieces.
- The pawn may move forward to the unoccupied square immediately in front of it on the same file; or on its first move it may advance two squares along the same file provided both squares are unoccupied; or it may move to a square occupied by an opponent's piece which is diagonally in front of it on an adjacent file, capturing that piece. The pawn has two special moves: the en passant capture and pawn promotion.

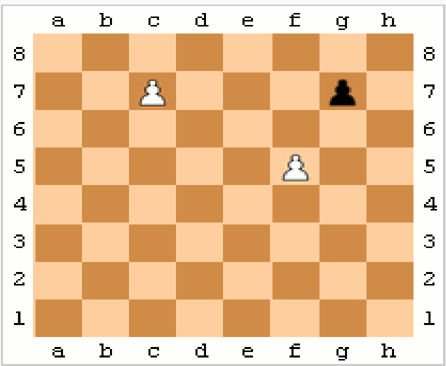


t

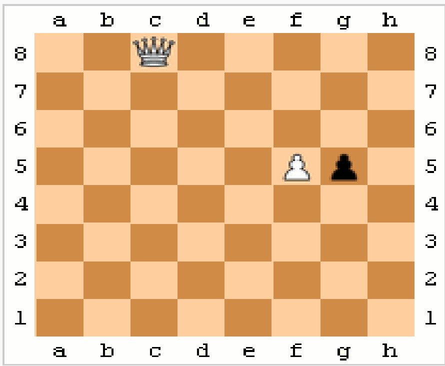
Examples of castling



Examples of castling



Examples of pawn moves: promotion (left) and *en passant* (right)



Examples of pawn moves: promotion (left) and *en passant* (right)

FIGURE: CASTLING AND PAWN EN-PASSANT

TIME CONTROL

Besides casual games without any time restriction, chess is also played with a time control, mostly by club and professional players. If a player's time runs out before the game is completed, the game is automatically lost (provided his opponent has enough pieces left to deliver checkmate). The duration of a game ranges from long games played up to seven hours to shorter rapid chess games, usually lasting 30 minutes or one hour per game. Even shorter is blitz chess, with a time control of three to fifteen minutes for each player, and bullet chess (under three minutes). In tournament play, time is controlled using a game clock that has two displays, one for each player's remaining time.

PORTABLE GAME NOTATOIN

Portable Game Notation (PGN) is a computer - processible format for recording chess games (both the moves and related data); many chess programs recognize this extremely popular format due to its being stored in plain text

BRIEF HISTORY

PGN was devised around 1993, by Steven J. Edwards, and was first popularized via the Usenet newsgroup rec.games.chess.

PGN is structured "for easy reading and writing by human users and for easy parsing and generation by computer programs." The chess moves themselves are given in algebraic chess notation. The usual filename extension is ".pgn".

USAGE

There are two formats in the PGN specification, the "import" format and the "export" format. The import format describes data that may have been prepared by hand, and is intentionally lax; a program that can read PGN data should be able to handle the somewhat lax import format. The export format is rather strict and describes data prepared under program control, similar to a pretty printedsource program reformatted by a compiler. The export format representations generated by different programs on the same computer should be exactly equivalent, byte for byte.

PGN code begins with a set of "tag pairs" (a tag name and its value), followed by the "move text" (chess moves with optional commentary).

TAG PAIRS

Tag pairs begin with an initial left bracket "[", followed by the name of the tag in plain text (ASCII). The tag value is enclosed in double-quotes, and the tag is then terminated with a closing right bracket "]". There are no special control codes involving escape characters, or carriage returns and linefeeds to separate the fields, and superfluous embedded spaces (or SPC characters) are usually skipped when parsing.

PGN data for archival storage is required to provide seven bracketed fields, referred to as "tags" and together known as the STR (Seven Tag Roster). In export format, the STR tag pairs must appear before any other tag pairs that may appear, and in this order:

1. Event: the name of the tournament or match event.
2. Site: the location of the event. This is in "City, Region COUNTRY" format, where COUNTRY is the three-letter International Olympic Committee code for the country. An example is "New York City, NY USA".
3. Date: the starting date of the game, in YYYY.MM.DD form. "??" are used for unknown values.
4. Round: the playing round ordinal of the game within the event.
5. White: the player of the white pieces, in "last name, first name" format.
6. Black: the player of the black pieces, same format as White.
7. Result: the result of the game. This can only have four possible values: "1-0" (White won), "0-1" (Black won), "1/2-1/2" (Draw), or "*" (other, e.g., the game is ongoing).

The standard allows for supplementation in the form of other, optional, tag pairs. The more common tag pairs include:

- Annotator: The person providing notes to the game.
- Ply Count: String value denoting total number of half-moves played.
- Time Control: "40/7200:3600" (moves per seconds: sudden death seconds)
- Time: Time the game started, in "HH:MM:SS" format, in local clock time.
- Termination: Gives more details about the termination of the game. It may be "abandoned", "adjudication" (result determined by third-party adjudication), "death", "emergency", "normal", "rules infraction", "time forfeit", or "unterminated".
- Mode: "OTB" (over-the-board) "ICS" (Internet Chess Server)
- FEN: The initial position of the chess board, in Forsyth-Edwards Notation. This is used to record partial games (starting at some initial position). It is also necessary for chess variants such as Fischer random chess, where the initial position is not always the same as traditional chess. If a FEN tag is used, a separate tag pair "SetUp" must also appear and have its value set to "1".

MOVETEXT

The movetext describes the actual moves of the game. This includes move number indicators (numbers followed by either one or three periods; one if the next move is White's move, three if the next move is Black's move) and movetext Standard Algebraic Notation (SAN).

For most moves the SAN consists of the letter abbreviation for the piece, an "x" if there is a capture, and the two-character algebraic name of the final square the piece moved to. The letter abbreviations are "K" (king), "Q" (queen), "R" (rook), "B" (bishop), and "N" (knight). The pawn is given an empty abbreviation in SAN movetext, but in other contexts the abbreviation "P" is used. The algebraic name of any square is as per usual Algebraic chess notation; from white's perspective, the leftmost square closest to white is a1, the rightmost square closest to the white is h1, and the rightmost square closest to black side is a8.

In a few cases a more detailed representation is needed to resolve ambiguity; if so, the piece's file letter, numerical rank, or the exact square is inserted after the moving piece's name (in that order of preference). Thus, "Nge2" specifies that the knight originally on the g-file moves to e2.

SAN kingside castling is indicated by the sequence "O-O"; queenside castling is indicated by the sequence "O-O-O" (note that these are capital letter "O"s, not numeral "0"s). Pawn promotions are notated by appending an "=" to the destination square, followed by the piece the pawn is promoted to. For example: "e8=Q". If the move is a checking move, the plus sign "+" is also appended; if the move is a checkmating move, the number sign "#" is appended instead. For example: "e8=Q#".

An annotator who wishes to suggest alternative moves to those actually played in the game may insert variations enclosed in parentheses. He may also comment on the game by inserting Numeric Annotation Glyphs (NAGs) into the movetext. Each NAG reflects a subjective impression of the move preceding the NAG or of the resultant position.

If the game result is anything other than "*", the result is repeated at the end of the movetext.

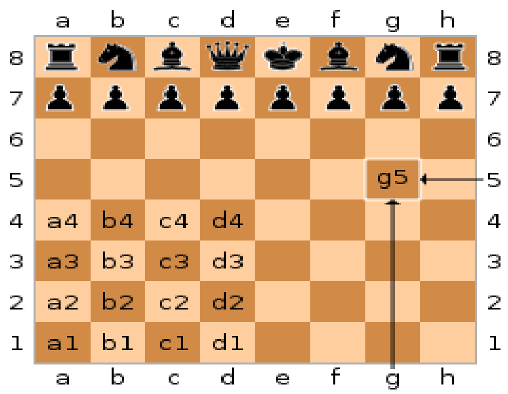


FIGURE: GAME NOTATION